Scientific and Technical Aerospace Reports

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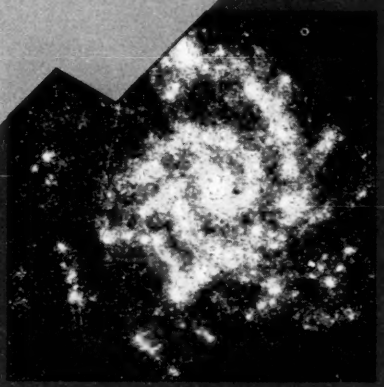

An Abstract Journal

NASA STI PROGRAM SCIENTIFIC & TECHNICAL INFORMATION

Volume 30, Number 9
May 8, 1992
N92-18006 to N92-19025

Scientific and Technical Aerospace Reports

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US ISSN 0036-8741

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Includes educational matters.

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SPACE SCIENCES For related information see also *Geosciences.*

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Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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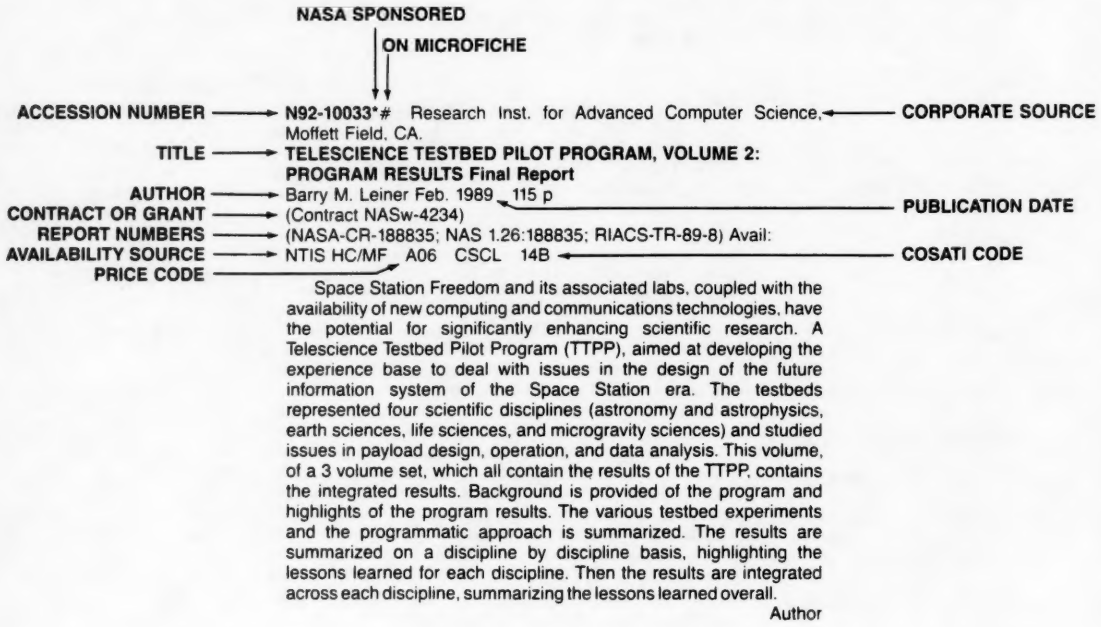
TYPICAL CITATION AND ABSTRACT



Space Station Freedom and its associated labs, coupled with the availability of new computing and communications technologies, have the potential for significantly enhancing scientific research. A Telescience Testbed Pilot Program (TTPP), aimed at developing the experience base to deal with issues in the design of the future information system of the Space Station era. The testbeds represented four scientific disciplines (astronomy and astrophysics, earth sciences, life sciences, and microgravity sciences) and studied issues in payload design, operation, and data analysis. This volume, of a 3 volume set, which all contain the results of the TTPP, contains the integrated results. Background is provided of the program and highlights of the program results. The various testbed experiments and the programmatic approach is summarized. The results are summarized on a discipline by discipline basis, highlighting the lessons learned for each discipline. Then the results are integrated across each discipline, summarizing the lessons learned overall.

Author

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Scientific and Technical Aerospace Reports

A Semimonthly Publication of the National Aeronautics and Space Administration

01 AERONAUTICS (GENERAL)

N92-18322# Manchester Univ. (England). Aeronautical Engineering Group.
THE GOLDSTEIN ENGINEERING RESEARCH LABORATORY
1989 61 p
(Aero-Rept-8906; ETN-92-90941) Avail: NTIS HC/MF A04

The Goldstein Laboratory is situated near Manchester (England). The experimental and computation facilities including an open jet tunnel, low turbulence wind tunnel, shock tubes, small wind tunnels, towing tasks for nonaeronautical fluid phenomena, stratified facilities, pulsating flow rig, and the computer system, are described. Profiles of research staff are given. Recent research programs, including jet noise investigations, computational fluid dynamics, high incidence aerodynamics, pulsating flow in tubes/blood flow in arteries, bluff body wakes, stratified flow, air to air refueling, and vortex dynamics are summarized. ESA

N92-18969# Federal Aviation Administration, Washington, DC.
NATIONAL AIRSPACE SYSTEM MAINTENANCE AND SUPPORT OPERATIONAL CONCEPT
William Trent, Thomas Pickerell, and Harold Nelson, Jr. (Computer Resource Management, Inc., Herndon, VA.) Jan. 1992 53 p
(Contract DTFA01-91-Y-01004)
(DOT/FAA/SE-92/1; NAS-SR-137) Avail: NTIS HC/MF A04

A requirement for the National Airspace System (NAS) is to provide for the maintenance and support of the NAS, as identified in the NAS System Requirement Specification, NAS-SR-1000. Presented here is a concept of operations for maintenance and support. These capabilities are described and the relations among subsystems, facilities, information, and operators/users are shown. The intention is to provide a common perspective for personnel involved in maintenance and support services, assist in determining whether procedures meet formal requirements, and support coordination among the organizations involved. Author

02 AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery.

For related information see also *34 Fluid Mechanics and Heat Transfer.*

N92-18007# Applied Research Lab., State College, PA.
A STUDY OF THE DIFFUSION OF SLOT-INJECTED DRAG-REDUCING POLYMER SOLUTION IN A TURBULENT BOUNDARY LAYER MODIFIED BY LARGE-EDDY BREAKUP DEVICES
Steven T. Sommer and Howard L. Petrie Nov. 1991 155 p
(Contract N00039-88-C-0051)
(AD-A243411; ARL/PSU/TR-92-015) Avail: NTIS HC/MF A08 CSCL 07/6

The effects of a tandem set of large-eddy breakup (LEBU) devices on the diffusion of drag-reducing polymer solution and of water injected into a turbulent boundary layer (TBL) flow have been studied. Laser-Doppler velocimeter measurements were taken in the LEBU modified TBL with and without polymer injection. A laser-induced fluorescence technique was used to examine the development of concentration profiles of the injected fluids with increasing distance from the injection slot for a range of injected rates. The diffusion rate of water, a passive contaminant, was diminished by the LEBU devices over a distance of only 10 to 15 boundary thicknesses before returning to the case of an unmodified flow. It has been found that the initial diffusion zone of the passive contaminant has been extended in the LEBU modified TBL. The LEBU devices did have a major effect on the diffusion of polymer over the entire steamwise distance studied, compared to the case of an unmodified flow. Large reductions of turbulent normal and shear stresses were observed downstream of the devices, especially with polymer injection. GRA

N92-18193 Department of the Navy, Washington, DC.
WINDOW COOLING FOR HIGH SPEED FLIGHT Patent
Richard T. Driftmyer, inventor (to Navy) 14 May 1991 4 p
Filed 27 Apr. 1990 Supersedes AD-D014686
(AD-D015145; US-Patent-5,014,932; US-Patent-Appl-SN-517011; US-Patent-Class-244-117) Avail: US Patent and Trademark Office CSCL 20/4

A buffering portion of boundary layer flow along a flight vehicle surface is diverted into an internal cavity at a downstream edge of a surface mounted window isolating recirculating flow of the diverted fluid through the cavity while it is cooled there within. Outflow of the cooled buffering fluid from an upstream edge of the window is conducted into the buffering portion of the boundary layer flow to cool the window and prevent damage thereof by aerodynamically generated heating of the surface under high velocity flight conditions. GRA

N92-18231# Manchester Univ. (England). Aeronautical Engineering Group.
MARCHING WITH THE PARABOLIZED NAVIER-STOKES EQUATIONS. PROBLEM 1: NUMERICAL STUDY OF HYPERSONIC VISCOUS CONE FLOW
S. Shahpar, I. M. Hall, and D. I. A. Poll 1990 22 p
(Aero-Rept-9007; ETN-92-90924) Avail: NTIS HC/MF A03

A general noniterative, three dimensional parabolized Navier-Stokes code was developed to predict the steady viscous flow field about objects traveling at high supersonic/hypersonic speeds. The equations are solved with an implicit approximate factorization finite difference scheme which is second order accurate in the cross flow directions. An implicit boundary condition was used which was compatible with the finite difference schemes used on the interior mesh. The grid used is generated by a simple algebraic method. Vigneron's technique was used to suppress the departure solution. The code is applied to laminar hypersonic flow, M(sub infinity) = 9.16, Re(sub infinity) = 5.5 times 10 to the 7th power/m, past a slender cone to 7 degree half angle and the computed shock shape, surface pressure, skin friction, and Stanton number are presented for comparison with experimental results. ESA

N92-18232# Manchester Univ. (England). Aeronautical Engineering Group.
MARCHING WITH THE PARABOLIZED NAVIER-STOKES EQUATIONS. PROBLEM 2: HYPERSONIC VISCOUS FLOW

OVER A FLAT PLATE
S. Shahpar, I. M. Hall, and D. I. A. Poll 1990 16 p
(Aero-Rept-9008; ETN-92-90925) Avail: NTIS HC/MF A03

The noniterative implicit space marching Parabolized Navier-Stokes (PNS) code described previously was used to compute the steady hypersonic (M(sub infinity) = 5 and 10), viscous (Re(sub infinity)/m = 0.000006 and Re(sub infinity)/m = 0.000003) flow fields over a flat plate aligned with the freestream. Flow maps for density, pressure, and Mach number as well as surface pressure, skin friction, and Stanton number are presented for comparison with experimental results. ESA

N92-18233# Manchester Univ. (England). Aeronautical Engineering Group.
ZONAL SOLUTIONS FOR A DOUBLE-ELLIPSE IN A HYPERSONIC FLOWFIELD
S. Shahpar, I. M. Hall, and D. I. A. Poll 1990 17 p
(Aero-Rept-9009; ETN-92-90926) Avail: NTIS HC/MF A03

Numerical solutions for inviscid flows past a double ellipse configuration at Mach numbers of 8.15 and 25.0 are presented. An overlapping grid system is developed and applied in the solution of hypersonic flow (M(sub infinity) = 8.15 and 25.0) over a double ellipse. The flow of information across the interfaced boundaries is achieved by linear interpolation. The two dimensional Euler equations are solved explicitly using a second order Runge-Kutta time stepping scheme. The procedure is also capable of treating three dimensional flows. ESA

N92-18239# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.
AN IMPROVED METHOD FOR SIMULATING SUPERSONIC FLOW PAST A WEDGE SHAPED BODY
Kunio Nomizo Feb. 1991 18 p In JAPANESE; ENGLISH summary
(NAL-TR-1097; ISSN-0389-4010) Avail: NTIS HC/MF A03

Several reports have obtained numerical solutions for supersonic flow past blunt nosed body, and in every case the method adopted can be described as an inverse marching process. This method was applied to a wedge shaped body, thus requiring an elliptical type equation to be solved. To facilitate the solution process, the pressure and density terms are eliminated from the equation so that it is composed solely of velocity terms. An initial application is discussed which constructs the solution starting from shock waves, the Taylar maccoll solution, with satisfactory results being obtained. Author

N92-18269# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
DESIGN AND TESTING OF HIGH-PERFORMANCE PARACHUTES
R. C. Maydew, C. W. Peterson, and K. J. Orlik-Rueckemann (Institute for Aerospace Research, Ottawa, Ontario) Nov. 1991 302 p Original contains color illustrations
(AGARD-AG-319; ISBN-92-835-0649-9) Copyright Avail: NTIS HC/MF A14; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Provided here are general state-of-the-art procedures for the design and testing of high-performance parachutes. This includes the use of aerodynamic and structural analysis and application of numerical codes to predict parachute inflation, deceleration forces, payload and parachute trajectories, and canopy/suspension line stresses. Design problems such as parachute collapse, parachute line sail, parachute stability, and body-wake interaction are discussed. The use of nylon, Nomex, Kevlar, Teflon, and other materials is covered. Techniques for the design and fabrication of prototype parachutes and deployment bags are presented, and parachute packing methods are discussed. A section is included on testing of model parachutes in wind tunnels. Full-scale testing, using a sled track or aircraft drop or rocket boost to deploy the parachute at the desired Mach number and altitude, and descriptions of onboard and ground-based instrumentation are outlined. Example parachute designs are given for differing system requirements of payload weight, deployment Mach number and dynamic pressure, parachute weight/volume, etc. Author

N92-18293# Manchester Univ. (England). Aeronautical Engineering Group.
A NUMERICAL STUDY OF THE STABILITY OF THE SWEPT ATTACHMENT LINE BOUNDARY LAYER Ph.D. Thesis
Vassilios Theofilis 1991 150 p Sponsored by Science Research Council
(Aero-Rept-9103; ETN-92-90934) Avail: NTIS HC/MF A07

The stability of the infinite swept attachment line boundary layer is studied numerically. A second order accurate finite differencing scheme is used in the normal to the wall direction, a pseudospectral approach is employed in the other directions; temporally, an explicit Crank-Nicholson scheme is used and the resulting system of equations is solved using an initial value problem approach. Extensive use of the fast Fourier transfrom algorithm was made to transform spaces. An important result is that, at a station off the attachment line, the critical Reynolds number for the onset instability is an order of magnitude smaller than the corresponding two dimensional critical Reynolds number at the attachment line. ESA

N92-18316# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
CALCULATION OF HYPERSONIC NON-EQUILIBRIUM VISCOUS FLOW USING SECOND ORDER BOUNDARY LAYER THEORY
C. Mundt and F. Monnoyer 3 Dec. 1990 11 p Presented at the International Aerospace Congress, Melbourne, Australia, 12-16 May 1991
(MBB-FE122-S-PUB-434; ETN-92-90615) Copyright Avail: NTIS HC/MF A03

A method is presented for the calculation of hypersonic boundary layers in chemical nonequilibrium. The second order boundary layer equations are solved using a finite difference space marching method. The flow and the chemistry are solved simultaneously and the latter is modeled by up to 17 reactions for a five species mixture describing high temperature reacting air. The transport properties are modeled accordingly. ESA

N92-18318# Manchester Univ. (England). Aeronautical Engineering Group.
TOWARDS THE COMPUTATION OF TURBULENT HYPERSONIC FLOWS
B. E. Launder (Manchester Coll. of Science and Technology, England) and D. I. A. Poll Aug. 1991 110 p
(Aero-Rept-9106; ETN-92-90937) Avail: NTIS HC/MF A06

The status of engineering turbulence modeling in relation to the problem of predicting hypersonic turbulent flows is considered. To provide a perspective for making such an assessment, the experimental data base and the associated experimental uncertainties are reviewed. Various levels of turbulence model are considered proceeding from the simplest (algebraic eddy viscosity models) to the most elaborate (multiple scale models based on transport equations for the turbulent stresses). No attempt is made to cover the problem of transition from laminar to turbulent flow in a quiescent free stream. Since, however, incompletely turbulent boundary layers are the general rule at hypersonic speed, particular attention is given to the capabilities of different levels of turbulence model in predicting flows with abnormally thick viscous sublayers. ESA

N92-18345# EMA, Mansfield, TX.
ROTORWASH COMPUTER MODEL: USER'S GUIDE Final Report, Dec. 1989 - Jun. 1990
Samuel W. Ferguson and J. David Kocurek Nov. 1991 156 p Prepared in cooperation with Computational Methodology Associates, Hurst, TX
(Contract DTRS57-87-P-81048)
(DOT/FAA/RD-90/25; EMA-TR-87-5-1) Avail: NTIS HC/MF A08

The user's guide for the Rotorwash (ROTWASH) Analysis

program is documented. This computer program is used to analyze the rotorwash flow field characteristics and their effect on the environment for rotorcraft in hovering and low speed flight in close proximity to the ground. Step by step descriptions are provided on the use of each analysis option along with a listing of the IMB PC/PC compatible based FORTRAN 77 software. The history is briefly described of the ROTWASH analysis software. References to the mathematical models used are included. Author

N92-18484# National Aerospace Lab., Tokyo (Japan). Advanced Aircraft Research Group.
AN APPROACH TO FLOW FIELD MEASUREMENT BY LASER 2-FOCUS VELOCIMETER (L2F) IN GUST WIND TUNNEL [TOPPU FUDOYO REZA 2 SHOTEN RYUSOKUKEI O MOCHIITA NAGAREBA KEISOKU NO KOKOROMI]
Kenichi Rinoie, Toshimi Fujita, Akihito Iwasaki, and Hirotoshi Fujieda Mar. 1990 25 p In JAPANESE
(NAL-TM-617; ISSN-0452-2982; JTN-92-80289) Avail: NTIS HC/MF A03

This report introduces the laser dual focus velocimeter of National Aerospace Laboratory (NAL) gust wind tunnel. The background, measurement theory, instruments configuration, data processing flow, and measurement error of this velocimeter are presented in the report. To present the accuracy and problems in using this velocimeter, some measurement results, such as the wind tunnel flow and stream line, are shown in this report. Author (NASDA)

N92-18760*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SEMI-EMPIRICAL MODEL FOR PREDICTION OF UNSTEADY FORCES ON AN AIRFOIL WITH APPLICATION TO FLUTTER
Aparajit J. Mahajan (Toledo Univ., OH.) and Krishna Rao V. Kaza Feb. 1992 28 p
(NASA-TM-105414; E-6820; NAS 1.15:105414) Avail: NTIS HC/MF A03 CSCL 01A

A semi-empirical model is described for predicting unsteady aerodynamic forces on arbitrary airfoils under mildly stalled and unstalled conditions. Aerodynamic forces are modeled using second order ordinary differential equations for lift and moment with airfoil motion as the input. This model is simultaneously integrated with structural dynamics equations to determine flutter characteristics for a two degrees-of-freedom system. Results for a number of cases are presented to demonstrate the suitability of this model to predict flutter. Comparison is made to the flutter characteristics determined by a Navier-Stokes solver and also the classical incompressible potential flow theory. Author

N92-18825# Micro Craft, Inc., Tullahoma, TN.
COMPUTATION OF A KELVIN-HELMHOLTZ INSTABILITY FOR DELTA WING VORTEX FLOWS Final Report, 1 Sep. 1990 - 1 Sep. 1991
Raymond E. Gordnier Nov. 1991 39 p
(Contract F33601-89-D-0045)
(AD-A244320; WL-TR-91-3098) Avail: NTIS HC/MF A03 CSCL 01/1

The structure of the shear layer which emanates from the leading edge of a 76 degrees sweep delta wing and forms the primary vortex is investigated numerically. The flow conditions are M at infinity = 0.2, Re = 50,000, and angle of attack of 20.5 degrees. Computational results are obtained using a Beam-Warning type algorithm. The existence of a Kelvin-Helmholtz type instability of the shear layer which emanates from the leading edge of the delta wing is demonstrated. A description is provided of the three-dimensional, unsteady behavior of the small-scale vortices associated with this instability. The numerical results are compared qualitatively with experimental flow visualizations exhibiting similar behavior. GRA

N92-18895# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN EXPERIMENTAL STUDY OF A STING-MOUNTED CIRCULATION CONTROL WING M.S. Thesis
Steven J. Lacher Dec. 1991 136 p
(AD-A243912; AFIT/GAE/ENY/91D-4) Avail: NTIS HC/MF A07 CSCL 01/1

This wind tunnel study investigated the lift, drag, and pitching moment of a 20 percent thick, 8.5 percent camber, partial elliptical cross-section, single blowing slot, 2.325 aspect ratio, rectangular circulation control wing. The AFIT 5-foot wind tunnel was used. Lift and drag were referenced to the wind axis. The Reynolds number was 500,000 for all tests. Angle of attack was varied from -6 to 16 degrees and the effects of pulsed blowing were investigated. Effects of tripping the Coanda jet with a small flow barrier attached spanwise along the Coanda surface were also studied. Results indicate that there is a limit on maximum lift obtainable by increasing circulation. The limit is presumed to be the result of three-dimensional effects. Pulsed blowing has little effect on average lift, but results in violent oscillation of the wing as the sting physically bends under cyclic loading. In certain situations, tripping the Coanda jet may reduce drag without decreasing lift. GRA

N92-19002*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
INSTALLATION EFFECTS OF WING-MOUNTED TURBOFAN NACELLE-PYLONS ON A 1/17-SCALE, TWIN-ENGINE, LOW-WING TRANSPORT MODEL
Odis C. Pendergraft, Jr., Anthony M. Ingraldi, Richard J. Re, and Timmy T. Kariya (Vigyan Research Associates, Inc., Hampton, VA.) Mar. 1992 108 p
(NASA-TP-3168; L-16960; NAS 1.60:3168) Avail: NTIS HC/MF A06 CSCL 01A

A twin-engine, low-wing transport model, with a supercritical wing of aspect ratio 10.8 designed for a cruise Mach number of 0.77 and a lift coefficient of 0.55, was tested in the Langley 16-Foot Transonic Tunnel. The purpose of this test was to compare the wing-nacelle interference effects of flow-through nacelles simulating superfan engines (very high bypass ratio (BPR is approx. = 18) turbofan engines) with the wing-nacelle interference effects of current-technology turbofans (BPR is approx. = 6). Forces and moments on the complete model were measured with a strain-gage balance, and extensive external static-pressure measurements (383 orifice locations) were made on the wing, nacelles, and pylons of the model. Data were taken at Mach numbers from 0.50 to 0.80 and at model angles of attack from -4 deg to 8 deg. Test results indicate that flow-through nacelles with a very high bypass ratio can be installed on a low-wing transport model with a lower installation drag penalty than for a conventional turbofan nacelle at a design cruise Mach number of 0.77 and lift coefficient of 0.55. Author

N92-18783# Wright Lab., Wright-Patterson AFB, OH.
NON-LINEAR AIRLOADS HYPERSURFACE REPRESENTATION: A TIME DOMAIN PERSPECTIVE
J. E. Jenkins and E. S. Hanff (National Aeronautical Establishment, Ottawa, Ontario) *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 9 p Sponsored in part by AFOSR and Dept. of National Defence (For primary document see N92-18778 09-05)
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03 AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents.

For related information see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

N92-18182# National Aerospace Lab., Tokyo (Japan).
INVESTIGATION ON FREEZING AND STICKING PHENOMENA OF SLUSH ON AIRPLANE SURFACES WHEN TAXIING ON THE GROUND AND THE SUCCEEDING TAKE-OFF RUN PHASE

Kingo Takagawa and Fumiko Ito Aug. 1989 20 p In JAPANESE; ENGLISH summary
(NAL-TR-1026; ISSN-0389-4010) Avail: NTIS HC/MF A03

An analytical study was conducted on the freezing and sticking phenomena of slush on the horizontal tail surfaces of a twin turboprop transport in the ground taxiing and takeoff run phase. A simple mathematical model describing the outflow of heat from slush to the surrounding airflow through the boundary layer is proposed. Both the conductive heat transfer and the heat transportation accompanied by the evaporation of water from slush are taken into account. The influences upon the heat transfer rate caused by climatic and operational conditions such as the atmospheric temperature, dew point, ground speed, suction coefficient over the horizontal tail surfaces, propeller slip stream effects, and the roughened surface covered by the slush are quantitatively evaluated. Under the climatic conditions occasionally experienced by airline operations in winter, the outflow of heat sufficient to stick the elevators is predicted for the 5-minute ground operation after the starting of the engines and the following 25 second takeoff. During the course of analysis, the conditions which cause, and the factors which accelerate, the freezing of slush are defined. Author

N92-18242# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
TECHNICAL EVALUATION REPORT ON THE FLUID DYNAMICS PANEL SPECIALISTS' MEETING ON EFFECTS OF ADVERSE WEATHER ON AERODYNAMICS
John J. Reinmann and J. W. Slooff, ed. (National Aerospace Lab., Amsterdam, Netherlands) Nov. 1991 26 p
(AGARD-AR-306; ISBN-92-835-0646-4) Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The proceedings of the conference are summarized. The purpose of the meeting was to provide an update of the state of the art with respect to the prediction, simulation, and measurement of the effects of icing, anti-icing fluids and various forms of precipitation on the aerodynamic characteristics of flight vehicles. Sessions were devoted to introductory and survey papers and icing certification issues, to analytical and experimental simulation of ice frost contamination and its effects on aerodynamics, and to the effects of heavy rain and deicing and/or anti-icing fluids. The 19 papers announced for the meeting are published in AGARD CP-496. Author

N92-18259# Walter Kidde Aerospace, Inc., Wilson, NC.
FEASIBILITY OF SYSTEMATIC RECYCLING OF AIRCRAFT HALON EXTINGUISHING AGENTS Final Report, Sep. 1990 - Aug. 1991
Mark D. Mitchell Dec. 1991 224 p
(Contract DTFA03-90-C-00039)
(DOT/FAA/CT-91/21; Rept-61423) Avail: NTIS HC/MF A10

A study was performed to determine the feasibility of recycling Halon 1301 extinguishing agent for support of the United States civil aircraft fleet until 2020. Research for this study centered around known relationships of refrigerants; the scientific principles of Avogadro, Dalton, Henry, and Raoult; and the physical properties of Halon 1301. Results of the study demonstrate that recovery of Halon 1301 to military specification purity requirements is practical. Agent recovery efficiency of 98 percent (minimum) can be expected, and the recovered agent can meet applicable purity requirements, except for a maximum noncondensible gas content of 10 pounds per square inch partial pressure at 70 F. Support of current and future United States domestic fleet until 2020 and beyond requires less than 5 percent of the projected 1994 Halon 1301 bank. Author

04 AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control.

For related information see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *Communications and Radar.*

N92-18112# Federal Aviation Administration, Atlantic City, NJ.
VISUAL APPROACH DATA COLLECTION AT SAN FRANCISCO INTERNATIONAL AIRPORT (SFO) Final Report, 9 Nov. 1989 - 12 Mar. 1990
Kathy M. Richards, Amy E. Transue, and Dominic Timoteo Jan. 1992 49 p
(DOT/FAA/CT-90/23) Avail: NTIS HC/MF A03

Data on aircraft executing simultaneous visual approaches to parallel runways 28R and 29L were collected at San Francisco International Airport (SFO) between 9 Nov. 1989 to 12 Mar. 1990. The purpose of data collection was to analyze the navigational characteristics of aircraft flying the 'fly visual' segment of the approach. Aircraft position data were collected using the in-place Bay Terminal Radar Approach Control Facility (TRACON) Airport surveillance primary and secondary radars. Author

N92-18729# Lancaster Univ. (England). Dept. of Operational Research.
AN EVALUATION OF THE ROYAL AIR FORCE SHORTS TUCANO NAVIGATION INSTRUMENTS TRAINER: THE NAVIT M.S. Thesis
Julie Goatham 1990 73 p Sponsored by Royal Air Force
(ETN-92-90841) Copyright Avail: NTIS HC/MF A04

The Navigation Instruments Trainer (NAVIT) was designed for pre-flying practice of navigation techniques and procedures, in order to alleviate problems encountered with the horizontal situation indicator and the radio magnetic indicator of the high perfornamce turboprop Shorts Tucano, used in the Royal Air Force training program. An evaluation of whether or not the NAVIT was achieving the tasks for which it was designed was made. Alternatives available for future computer based training packages and requiremnts for further evaluation of the NAVIT, when student pilots have continued through the pilot training process to ascertain the long term effects of the NAVIT, are discussed. ESA

N92-18967# Federal Aviation Administration, Washington, DC.
EVALUATION OF ADVANCED MICROWAVE LANDING SYSTEM PROCEDURES IN THE NEW YORK TERMINAL AREA
Barry C. Scott, Jim Dargue, and Tsuyoshi Goka (Goka, Tsuyoshi Avionics, Sunnyvale, CA) Dec. 1991 122 p
(DOT/FAA/ND-91/1) Avail: NTIS HC/MF A06

In 1988, the Federal Aviation Administration (FAA) established the Microwave Landing System (MLS) Program Office and initiated a series of projects designed to demonstrate the operational, environmental, and economic benefits of the MLS. The results of the first simulation conducted under the project titled 'Evaluation of Complex MLS Procedures in Multi-Airport Environments' are presented. This initial experiment involved LaGuardia, John F. Kennedy, and Newark airports in the New York Terminal Control Area. Overall, the pilots said that the MLS procedures that were flown were operationally acceptable to them. Speed control was deemed to be very important in that the aircraft should be in final configuration prior to the Precision Final Approach Fix so that the speed would not be changing during the turning portion of the procedure. There was universal agreement that the procedures were much easier to fly than originally anticipated. Author

05 AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology.

For related information see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*.For land transportation vehicles see *85 Urban Technology and Transportation.*

N92-18024*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
HI-ALPHA FOREBODY DESIGN. PART 1: METHODOLOGY BASE AND INITIAL PARAMETRICS Report, 17 Jul. 1989 - 15 Jul. 1990
William H. Mason and R. Ravi Jan. 1992 146 p
(Grant NAG1-1037)
(NASA-CR-189849; NAS 1.26:189849; VPI-Aero-176-Rev) Avail: NTIS HC/MF A07 CSCL 01C

The use of Computational Fluid Dynamics (CFD) has been investigated for the analysis and design of aircraft forebodies at high angle of attack combined with sideslip. The results of the investigation show that CFD has reached a level of development where computational methods can be used for high angle of attack aerodynamic design. The classic wind tunnel experiment for the F-5A forebody directional stability has been reproduced computationally over an angle of attack range from 10 degrees to 45 degrees, and good agreement with experimental data was obtained. Computations have also been made at combined angle of attack and sideslip over a chine forebody, demonstrating the qualitative features of the flow, although not producing good agreement with measured experimental pressure distributions. The computations were performed using the code known as cfl3D for both the Euler equations and the Reynolds equations using a form of the Baldwin-Lomax turbulence model. To study the relation between forebody shape and directional stability characteristics, a generic parametric forebody model has been defined which provides a simple analytic math model with flexibility to capture the key shape characteristics of the entire range of forebodies of interest, including chines. Author

N92-18038*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Aerospace and Ocean Engineering.
HI-ALPHA FOREBODY DESIGN. PART 2: DETERMINATION OF BODY SHAPES FOR POSITIVE DIRECTIONAL STABILITY Final Report, 15 Aug. 1990 - 15 Aug. 1991
R. Ravi and William H. Mason 2 Feb. 1991 86 p Revised
(Grant NAG1-1037)
(NASA-CR-189850; NAS 1.26:189850; VPI-Aero-182-Rev) Avail: NTIS HC/MF A05 CSCL 01C

Computational Fluid Dynamics (CFD) has been used to study aircraft forebody flowfields at low speed high angle-of-attack conditions with sideslip. The purpose is to define forebody geometries which provide good directional stability characteristics under these conditions. The flows of the F-5A forebody and Erickson forebody were recomputed with better and refined grids. The results were obtained using a modified version of cfl3d to solve either the Euler equations or the Reynolds equations employing a form of the Baldwin-Lomax turbulence model. Based on those results, we conclude that current CFD methods can be used to investigate the aerodynamic characteristics of forebodies to achieve desirable high angle-of-attack characteristics. An analytically defined generic forebody model is described, and a systematic study of forebody shapes was then conducted to determine which shapes promote a positive contribution to directional stability at high angle-of-attack. A novel way of presenting the results is used to illustrate how the positive contribution arises. Based on the results of this initial parametric study, some guidelines for aerodynamic design to promote positive directional stability are presented. Author

N92-18073# National Aeronautical Lab., Bangalore (India). Flight Mechanics and Controls Div.
DYNAMIC FLYING INVESTIGATIONS ON 1/13.5 NALLA MODEL (LONGITUDINAL RESULTS)
S. Balakrishna, T. Niranjana, S. R. Rajan, and M. S. Rajamurthy Jul. 1991 30 p
(NAL Proj. ID-7-117H)
(NAL-PD-FC-9113) Avail: NTIS HC/MF A03

A 1/13.5 scale National Aeronautical Laboratory Light Aircraft (NALLA) model was instrumented and dynamically flown with one degree of freedom. Experiments were conducted at center of gravity (CG) locations of 0.28 bar-C and 0.43 bar-C. The neutral point of the configuration was shown to be in the range of 0.57 bar-C to 0.58 bar-C, suggesting aft loading. The power effect was shown to be a pitch up above 10 degrees alpha trim and a pitch down below 10 degrees alpha. Author

N92-18096 ESDU International Ltd., London (England).
STATISTICAL METHODS APPLICABLE TO ANALYSIS OF AIRCRAFT PERFORMANCE DATA
Oct. 1991 34 p
(ESDU-91017; ISBN-0-85679-779-0; ISSN-0141-4054) Avail: ESDU

A flowchart is used to guide its user in the application of statistical techniques to the analysis of performance data from which all but random variability has been removed; that is, they have been reduced to standard conditions. The possibility of combining small samples in a larger sample, so improving the accuracy of predictions, is considered. Fisher's Variance Ratio F test is used to decide with a certain confidence whether the samples are from the same population, and Student's t test determines the significance between sample means. Larger samples, exceeding 30 points, either from combined smaller samples or as measured, are treated using Normal distribution statistics provided the Chi squared test for normality with a chosen confidence is met. If the test fails, a transformation of the data (for example, taking the logarithm) may provide a Normal distribution. The use of probability graph paper as a means of analyzing data to the Normal distribution is explained. Regression is considered because, although not a statistical technique, the results are analyzed statistically. The manual calculation of linear two variable regression is discussed, and determination of variance about the regression line, the significance of the regression relationship, regression confidence intervals, and the correlation coefficient and its significance are treated. Multiple linear regression is briefly considered. Tables present the statistics of the Normal distribution, Student's t distribution, the Chi squared distribution and the F distribution. Examples on the use of the methods are found in ESDU 91018 to 91020. ESDU

N92-18333# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Hubschrauber und Flugzeuge.
DESIGN, ANALYSIS, AND TESTING OF INTEGRALLY STIFFENED COMPOSITE CENTRE FUSELAGE SKIN FOR FUTURE FIGHTER AIRCRAFT
L. Lemmer and H. Lonsinger 3 May 1991 21 p Presented at the 8th International Conference on Composite Materials, Honolulu, HI, 15-19 Jul. 1991
(MBB-FE2-PUB-S-450; ETN-92-90614) Copyright Avail: NTIS HC/MF A03

A center fuselage skin made of one piece carbon fiber composite monocoque with double curvature, stiffened with simultaneous curved frames and longerons, is described. The basic design, material selection and stressing of typical features are discussed and compared with test results. The design is assessed in terms of weight reduction and production cost considerations. ESA

N92-18347*# Alabama Univ., Huntsville. Materials Processing Lab.
PROCESS MODELING KC-135 AIRCRAFT Final Report
Gary L. Workman 19 Nov. 1991 38 p

(Contract NAS8-36955)
(NASA-CR-184278; NAS 1.26:184278) Avail: NTIS HC/MF A03 CSCL 01C

Instrumentation will be provided for KC-135 aircraft which will provide a quantitative measure of g-level variation during parabolic flights and its effect on experiments which demonstrate differences in results obtained with differences in convective flow. The flight apparatus will provide video recording of the effects of the g-level variations on varying fluid samples. The apparatus will be constructed to be available to fly on the KC-135 during most missions. Author

N92-18482# National Aerospace Lab., Tokyo (Japan). Flight Research Div.

A PRELIMINARY FLIGHT TEST ON A BASIC PERFORMANCE OF THE FLIGHT RESEARCH AIRPLANE Do 228: VELOCITY VS GLIDE PATH ANGLE

Yoshikazu Miyazawa, Takatsugu Ono, and Yasuhito Kawagoe (Tokyo Denki Univ., Japan) Oct. 1989 18 p
(NAL-TM-613; ISSN-0452-2982; JTN-92-80249) Avail: NTIS HC/MF A03

A preliminary flight test was conducted on the research airplane Dornier Do228-200 that is being modified for use as an in-flight simulator by the National Aerospace Lab (NAL). The basic performance of the aircraft was evaluated by the flight test. Glide path angles were examined with various parameters such as velocity, altitude, and power. The flight test results were compared with those of a mathematical model based on the Dornier GmbH wind tunnel test data. Since an onboard data acquisition system is under development and only primitive measurement is available, accuracy of the flight test is limited. This flight test, however, has verified the mathematical model to some extent, and has given useful data for future flight tests. Author (NASDA)

N92-18571# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.

FATIGUE MANAGEMENT

Dec. 1991 271 p In ENGLISH and FRENCH The 72d meeting was held in Bath, England, 29 Apr. - 3 May 1991
(AGARD-CP-506; ISBN-92-835-0642-1) Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

At its seventy-second meeting, the Structures and Materials Panel held a conference of specialists focussing on the problem of fatigue management. Today's trend is to retain aircraft in service much longer than originally planned. This trend, coupled with the facts that airframe structures are much more precisely optimized and advance active control systems are common, makes it essential that state of the art. fatigue monitoring procedures are used. Information from such systems is vitally important for efficient, cost effective fleet management. Such data are also important to procurement authorities when trying to plan aircraft replacements. For individual titles, see N92-18572 through N92-18595.

N92-18572# British Aerospace Public Ltd. Co., Preston (England). Fatigue and Fracture Technology Div.

THE DEVELOPMENT OF FATIGUE MANAGEMENT REQUIREMENTS AND TECHNIQUES

A. P. Ward *In* AGARD, Fatigue Management Dec. 1991 4 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Fatigue management requirements and techniques have evolved over a period of 40 years or more. This paper provides an overview of these developments. An historical summary is presented covering the introduction of the different monitoring techniques ranging from the simple V-g recorder through to the multi-channel systems with on-board processing that now exist. The paper concludes with a summary of the main requirements for modern systems and then identifies a number of key issues that should be addressed during the course of the Specialists' Meeting. Author

N92-18573# Centre d'Essais Aeronautique Toulouse (France). Div. Materiaux et Structures.

FATIGUE SAFETY FACTOR: ASSESSMENT OF ASSOCIATED SAFETY LEVEL **c39**

V. Dehaye *In* AGARD, Fatigue Management Dec. 1991 5 p In FRENCH (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Techniques related to the determination of fatigue reliability factors for aircraft structures are discussed. Particular attention is given to methods for the estimation of corresponding safety levels. Of central concern are those combat aircraft that have been reviewed according to the 'safe life' concept. The parameters affecting structural fatigue behavior are outlined. Approaches to fatigue reliability analysis used for the principle french combat fleet are addressed. Transl. by M.G.

N92-18574# Veritas Research A.S., Hovik (Norway).

PROBABILISTIC DESIGN AND FATIGUE MANAGEMENT BASED ON PROBABILISTIC FATIGUE MODELS WITH RELIABILITY UPDATING

R. Skjong, G. Sigurdsson, and M. K. Nygard *In* AGARD, Fatigue Management Dec. 1991 7 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The fatigue limit state is the governing limit state for an aging airframe. The trend of operating aircraft longer than their originally planned life, calls for extensive testing and inspection. Current practice is to base decisions with respect to inspections and repair on the durability and damage tolerance methodologies. These procedures make little use of probabilistic methods. The paper addresses the same basic problems of similar fundamental models. The formulations are, however, casted into a probabilistic format. In particular the possibility of incorporating new inservice information, based on inspection results or load measurements, is discussed and demonstrated. The advantage of this formulation is illustrated by some examples. Some comments are about future research that would be necessary to fully utilize the capabilities of probabilistic methods. Author

N92-18575# Wright Lab., Wright-Patterson AFB, OH. Structural Integrity Branch.

AGING AIRCRAFT STRUCTURAL DAMAGE ANALYSIS

J. G. Burns, W. P. Johnson, and A. P. Berens (Dayton Univ. Research Inst., OH.) *In* AGARD, Fatigue Management Dec. 1991 15 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The structural problems experienced by aging aircraft, both military and commercial, are described. The programs that are in place in the U.S. Air Force, the research that is being performed, and the facilities that are used to address the problem of aging aircraft are identified. The use of one research product, the computer program PRobability Of Fracture (PROF), describes how current technology can be used to predict damage in aging aircraft structures and the reliability of those structures. Areas where additional research is required are identified and conclusions are drawn. Author

N92-18576# Canadair Ltd., Montreal (Quebec). Military Aircraft Div.

A PROBABILISTIC PROCEDURE FOR AIRCRAFT FLEET MANAGEMENT

Y. Theriault and A. R. Colle *In* AGARD, Fatigue Management Dec. 1991 10 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A procedure for determining the probability of structural failure of an airplane at any stage of the operational life is described. This procedure is based on existing models for representing the size distribution of pre-service cracks, the distribution of the

maximum service load expected in a single flight, and the reliability of the nondestructive method used for inspection. A case study is presented to show how the procedure can help the fleet manager set more realistic inspection and maintenance schedules and adopt more appropriate retirement policies. Author

N92-18577# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
FATIGUE LIFE BEHAVIOUR OF COMPOSITE STRUCTURES
c24
W. Broecker and K. Woithe *In* AGARD, Fatigue Management Dec. 1991 10 p (For primary document see N92-18571 09-05)
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The general fatigue behavior of composite structures is presented. The verification and certification philosophy, depending on the special behavior of the material, is shown. On this basis a lot of structure tests were carried out, taking test parameters such as damages, environmental influence, and load conditions into consideration. The summary of these tests is presented. Author

N92-18578# National Aeronautical Establishment, Ottawa (Ontario). Structures and Materials Lab.
A PARAMETRIC APPROACH TO SPECTRUM DEVELOPMENT
D. L. Simpson, R. J. Hiscocks, and D. Zavitz *In* AGARD, Fatigue Management Dec. 1991 16 p Sponsored in part by Dept. of National Defence (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The parametric approach being pursued for the development of the test spectrum for the CF-18 center fuselage is described. An overview is provided of the F/A-18 International Follow-on Structural Test Program (IFOSTP) with emphasis on spectrum development. The specific technical elements of the spectrum development task are introduced and detailed information is provided on the CF-18 usage monitoring system, the approach to usage processing and the maneuver identification methodology which is forming the basis of the parametric approach to CF-18 spectrum development. A specific example of the maneuver identification process is provided and recommendations for future monitoring systems are offered. Author

N92-18579# Aerospatiale, Toulouse (France).
FATIGUE TESTING AND TEAR DOWN OPERATIONS ON AIRBUS A320 FORWARD FUSELAGE
R. Boetsch and J. Y. Beaufils *In* AGARD, Fatigue Management Dec. 1991 6 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The structural design substantiation of commercial transport aircraft is provided by full static and fatigue analyses supported by testing of complete primary structures. The fatigue and damage tolerance testing on full scale specimen representative of production aircraft and the teardown inspections performed at the end of the test permit the collection of a lot of data. Main objectives of fatigue tests are to identify weak points in primary structure and to quickly define corrective actions on in-service and production aircraft, and to check the efficiency of the inspection methods, to justify allowable damage and typical repairs of structural repair manuals, to study the propagation of artificial damages which are introduced during the test. The aim of teardown inspections is to verify and validate the inspection methods applied during the test on assembled structure and in addition to find hidden cracks with special nondestructive test methods. Also, from fatigue tests, areas will be found where there is a risk of wide spread fatigue damage and the performance of damage tolerance assessment on the basis of realistic cracking scenarios. Author

N92-18580# Alenia, Torino (Italy). Gruppo Aerei Difesa.
PROPOSAL FOR THE NEW FATIGUE MANAGEMENT SYSTEM FOR THE AMX
P. Amabile and T. Giacobbe *In* AGARD, Fatigue Management Dec. 1991 9 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The structural monitoring systems produced for the Italian Air Force are briefly presented and discussed. From the previous experience, a new proposal for AMX aircraft monitoring arose and is shown. The proposed system is based mainly on in-flight monitoring of strain gage measurements with storage of some flight parameters for special investigations or simplified back-up analysis in case of failures of the main system. Elaboration methods to be used both on-board and on ground are described. Measurements on static and fatigue tests on ground were studied for a correct tuning of the system. Author

N92-18581# National Defence Headquarters, Ottawa (Ontario). Directorate Aerospace Support Engineering.
DURABILITY AND DAMAGE TOLERANCE TESTING AND FATIGUE LIFE MANAGEMENT: A CF-18 EXPERIENCE
M. B. Zgela and W. B. Madley *In* AGARD, Fatigue Management Dec. 1991 16 p (For primary document see N92-18571 09-05)
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Each CF-18 multirole fighter is equipped with a multichannel data acquisition system which records a number of parameters including measured strains, engine data, and various flight incident data. The analysis of this data has enabled the close monitoring of aircraft usage and the rate at which each aircraft accumulated fatigue damage. In 1986, in-service analysis of CF-18 fleet usage indicated that the aircraft were being operated in a significantly different manner than assumed for design, and that severity of the usage approached or exceeded the spectrum used for certification testing. To ensure the maximum economic life of the fleet, a Fatigue Life Management Program (FLMP) was implemented along with Durability and Damage Tolerance Testing activities. The development is described of various components of the FLMP, including the aircrew fatigue awareness program, CF-18 Individual Aircraft Tracking activities, the development and implementation of fatigue damage control measures, and lessons learned from the management of the FLMP. Author

N92-18582# Aeritalia S.p.A., Naples (Italy). Viale dell'Aeronautica.
THE G-222 AIRCRAFT INDIVIDUAL TRACKING PROGRAMME
A. Minuto, A. Apicella, A. Lanciotti, and L. Lazzeri (Pisa Univ., Italy) *In* AGARD, Fatigue Management Dec. 1991 7 p (For primary document see N92-18571 09-05)
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The G-222 is a transport aircraft designed about 20 years ago; from the fatigue point of view, the design is of the conventional 'safe life' kind, verified by means of a full scale test. The aircraft was equipped with a counting accelerometer, whose recordings were used, together with the pilot compiled forms, for the evaluation of life consumption. In recent years, following the Damage Tolerance evaluation of the structure, a different approach has been developed for fatigue damage monitoring; the same input data are used for the prediction of crack growth. The main drawback of this approach is the lack of information about the sequence of load application, so that only non-interactive models can be properly used. For this reason, Aeritalia decided to improve the quality of in-flight recorded parameters, in order to get more data about the actual usage, while also taking the sequence of load application into account. The data acquisition approach is described and discussed. Author

N92-18583# National Aerospace Lab., Amsterdam (Netherlands).
LOAD MONITORING OF F-16 A/B AIRCRAFT OF THE RNLAF WITH A SMART ELECTRONIC DEVICE
D. J. Spiekhout *In* AGARD, Fatigue Management Dec. 1991

17 p (For primary document see N92-18571 09-05)
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Since the introduction of the F-16 weapon system in the RNLAF, load monitoring has been carried out with a mechanical strain recorder (MSR) in each aircraft and a flight loads recorder (FLR) in one sixth of the fleet. From 1990 on, these recorders have been replaced by instrumentation which is capable of recording peaks and troughs in the signal of a strain gage at the location of the MSR. This new instrumentation has been installed in three aircraft per squadron. The result is a calculated severity per mission type per squadron. By using the mission type mixture, the severity per base, squadron or tail number can be established. Inspection schemes, based on the recently developed fleet structural maintenance plan for the RNLAF, can be changed accordingly. Mission type and take off configuration for each flight is available from the debriefing form. Besides the single channel measurements, supporting measurements with more channels have been carried out. In this way, it was checked whether the load severity for the MSR location can be used for other structural locations. Author

N92-18584# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
AIRCRAFT TRACKING FOR STRUCTURAL FATIGUE
R. Neunaber *In* AGARD, Fatigue Management Dec. 1991 9 p (For primary document see N92-18571 09-05)
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Aircraft tracking is carried out for flight safety reasons, but with an increasing tendency also for economic reasons. With the latter aspect the cost-to-performance ratio becomes more and more important. To take care of both, for the WS Tornado, the parametric data acquisition of the crash recorder was extended to a multi-level tracking concept composed of the sectors temporary aircraft tracking, selected aircraft tracking, and individual aircraft tracking. The key elements of flight monitoring are the flight recorders that are distributed throughout all squadrons on a statistically representative basis and that register operating data for Selected Aircraft Tracking. In the Temporary Aircraft Tracking sector, the recorder parameter set also contains strain gauges in the various fatigue critical areas. Cyclical reading of these strain gauges ensures that any faults are revealed in the parametric algorithms. Individual Aircraft Tracking is carried out on the basis of a reduced pilot parameter set. The data transfer from the aircraft to the evaluation center for this task was converted from manual registration to electronic data processing, increasing the data processing capacity and at the same time significantly improving data quality. Author

N92-18585# Dassault-Breguet Aviation, Saint Cloud (France). Structure Div.
AIRCRAFT TRACKING OPTIMIZATION OF PARAMETERS SELECTION
R. J. Cazes and P. Defosse *In* AGARD, Fatigue Management Dec. 1991 12 p (For primary document see N92-18571 09-05)
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Any appropriate structural maintenance plan, based on a Safe-Life or a Damage Tolerance concept, is in close relation with the accuracy of in-service loads identification. The development of multichannel devices with integrated capabilities for in-flight pre-processing allows one to get in-service data and flight results about any critical part of the equipped aircraft, but with sometimes such an amount of computations that the 'should-be simple' in flight processing has to be transferred toward a ground facility. In order to reduce the volume of data for calculations (and their cost of acquisition), we studied the relative influence of the various flight parameters considered during the static and fatigue design of an aircraft. The calculated stresses and loads were compared with their same counterparts measured in flight. Their effects on fatigue values were quantified. This study was performed for the MIRAGE 2000 aircraft tracking and in service loads identification. Author

N92-18586# Deutsche Airbus G.m.b.H., Bremen (Germany, F.R.).
THE OPERATIONAL LOADS MONITORING SYSTEM, OLMS
V. Ladda and H.-J. Meyer *In* AGARD, Fatigue Management Dec. 1991 14 p (For primary document see N92-18571 09-05)
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The preservation of the damage tolerance qualities ensures the safe lifelong operation of aircraft. For this purpose and the assessment of fatigue life consumption, different methods have been developed to monitor the service experiences. Nowadays mainly two kinds of monitoring systems which are different in philosophy exist: first, the parametric system which records and processes only aircraft mission parameters, and second, the direct load/and or stress measurement system using strain gauges. The main advantages and disadvantages of both systems are discussed. A third possibility is to monitor the service experiences of aircraft by combining the advantages of both systems: this leads to the idea of Operational Loads Monitoring System (OLMS). In this contribution the advanced operational loads monitoring system OLMS, for a transport aircraft, is presented. Detailed descriptions are given concerning philosophy and realization. OLMS represents the on-board equipment for the Airframe Condition Monitoring Procedure (ACMP) which takes care of damage tolerance qualities and which will increase the efficiency of structural inspections. The OLMS as presented in this contribution is adaptable to all transport and combat aircraft with electronic flight control systems (EFCS). The verification has been performed on the test aircraft by means of strain gauge measurements. Results of the OLMS-computer simulation program as well as results of the flight test verification are presented. Author

N92-18587# Aeronautical Systems Div., Wright-Patterson AFB, OH.
LIFE MANAGEMENT APPROACH FOR USAF AIRCRAFT
John W. Lincoln *In* AGARD, Fatigue Management Dec. 1991 10 p (For primary document see N92-18571 09-05)
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The USAF Aircraft Structural Integrity Program, that traces its origin to B-47 failures in 1958, was established based on the recognition that repeated loads were a threat to the safety of operational aircraft. Later, it was recognized that manufacturing and in-service damage also had the potential to degrade their safety. This threat has been successfully controlled through the adoption of the damage tolerance approach in 1975. This approach, also referred to as 'retirement for cause,' is used as a basis for an inspection/modification program to maintain safety throughout the lift of the aircraft. However, when the aircraft structure has degraded to the point that multiple site damage has occurred, then the inspection program that was developed for the pristine structure needs to be changed. It is the purpose of this paper to review the occurrences of multiple site damage on USAF aircraft and how this has influenced their lives. This will be done through the experiences derived from the KC-135, C-5 and C-141 aircraft. Author

N92-18588*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
LARGE AREA QNDE INSPECTION FOR AIRFRAME INTEGRITY
William P. Winfree and Joseph S. Heyman *In* AGARD, Fatigue Management Dec. 1991 5 p (For primary document see N92-18571 09-05)
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Quantitative Nondestructive Evaluation (QNDE) technology is being developed to provide new options for cost effective inspection

of airframes. An R&D effort based on five NDE technologies is addressing questions of structural bonding assessment, corrosion detection, multisite damage detection, and fatigue characterization. The research/applications are being conducted by prioritized focussing and staging of the following technologies: (1) thermal NDE; (2) ultrasonic NDE; (3) coherent optical NDE; (4) magnetic imaging NDE; and (5) radiographic NDE. The focus here is on the most recent applications of thermal NDE technology to large area inspection of lap-joint and stiffener bonds. The approach is based on pulsed radiant heating of the airframe and measurement of the surface temperature of the structure with an infrared imager. Several advantages of the technique are that it is noncontacting, inspects one square meter area in a period of less than 2 minutes and has no difficulty inspecting typical curvatures of the fuselage. Numerical models of heat flow in these geometries are used to determine appropriate techniques for reduction of the infrared images, thereby delineating regions of disbonds. These models are also used to determine the optimum heating and measurement times for maximizing the contrast between bonded and unbonded structures. Good agreement is found between these results and experimental measurements, and a comparison of the two are presented. Also presented are results of measurements on samples with fabricated defects which show the technique is able to clearly indicate regions of disbonds. Measurements on an airframe also clearly image subsurface structure. Author

N92-18589*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
RECENT FRACTURE MECHANICS RESULTS FROM NASA RESEARCH RELATED TO THE AGING COMMERCIAL TRANSPORT FLEET
Charles E. Harris *In* AGARD, Fatigue Management Dec. 1991 6 p (For primary document see N92-18571 09-05)
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NASA is conducting the Airframe Structural Integrity Program in support of the aging commercial transport fleet. This interdisciplinary program is being worked in cooperation with the U.S. airframe manufacturers, airline operators, and the FAA. Advanced analysis methods are under development to predict the fatigue crack growth in complex built-up shell structures. Innovative nondestructive examination technologies are also under development to provide large area inspection capability to detect corrosion, disbonds, and fatigue cracks. Recent fracture mechanics results applicable to predicting the growth of cracks initiating at the rivets of fuselage splice joints are reviewed. Author

N92-18590# Boeing Commercial Airplane Co., Seattle, WA.
STRUCTURAL AIRWORTHINESS OF AGING BOEING JET TRANSPORTS
Jack F. McGuire and Ulf G. Goranson *In* AGARD, Fatigue Management Dec. 1991 10 p (For primary document see N92-18571 09-05)
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Boeing is dedicated to design and manufacture safe commercial jet transports. The successful accomplishment of this responsibility over the last three decades has contributed significantly to a position of industry leadership and reflects the top priority given to safety. This paper illustrates that the structural integrity assurance of commercial airplane structures is a serious and disciplined process. High standards must be maintained to ensure the safety of aging airplanes until economics dictate their retirement. Standard Boeing practices to ensure continuing structural integrity include providing structural maintenance programs, continuous communication through customer support services, and recommendations for maintenance actions through service letters, structural item interim advisories, and service bulletins. To help identify potential problems associated with the aging jet transport fleet, Boeing has implemented additional activities: (1) supplemental structural inspection programs that require airlines to regularly inspect structurally significant items on selected older airplanes and report defects to Boeing for prompt fleet action; (2) teardown of older airframes to help identify corrosion and other structural service defects; (3) fatigue testing of older airframes to determine structural behavior in the presence of service-induced problems such as corrosion and repairs; and (4) an engineering assessment of the condition of a representative sample of older Boeing airplanes to observe effectiveness of corrosion prevention features and acquire additional data that might improve maintenance recommendations to the operators. Aging fleet concerns have also resulted in joint industry, airlines, and airworthiness authority actions. These initiatives have provided timely preventive structural maintenance recommendations and permit continued safe operation of aging jet transports until their retirement from service. Author

N92-18591# Ministry of Defence, London (England).
AIRCRAFT FATIGUE MANAGEMENT IN THE ROYAL AIR FORCE
M. E. J. Render and J. E. Stevens (Royal Air Force, Dereham, England) *In* AGARD, Fatigue Management Dec. 1991 14 p (For primary document see N92-18571 09-05)
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An overview of how fatigue is managed for all of the Royal Air Force (RAF) Aircraft Fleets is presented. The main theme is the Tornado Aircraft since it represents the largest portion of the capital value of the RAF inventory. The RAF has three objectives for their aircraft structural integrity policy: to make aircraft operations as safe as is reasonably possible; to ensure that the aircraft are available to the front line; and to minimize the costs. Author

N92-18592# Bundesamt fuer Wehrtechnik und Beschaffung, Munich (Germany, F.R.).
TORNADO STRUCTURAL FATIGUE LIFE ASSESSMENT OF THE GERMAN AIR FORCE
Paul Fraas and Ambros Goellner (Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn, Germany, F.R.) *In* AGARD, Fatigue Management Dec. 1991 10 p (For primary document see N92- 18571 09-05)
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The structural development and the fatigue verification of the Tornado Program was completed. The majority of the aircraft were delivered to the German Air Force and some of them were in full operational use for a period of one decade. This is considered a suitable time to review the approach for ensuring the long-term structural airworthiness, from the users point of view. Author

N92-18593# Portuguese Air Force, Alfragide.
FATIGUE MANAGEMENT FOR THE A-7P
Daniel Santos *In* AGARD, Fatigue Management Dec. 1991 19 p (For primary document see N92-18571 09-05)
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One objective of an Aircraft Structural Integrity Program (ASIP) is to ensure that all primary structure is both durable and damage tolerant; that is, it is able to resist both cracking and failure due to cracking. The heart of any durability and damage tolerance assessment is crack growth predictions. This requires a crack growth program, accurate stress intensity and load interaction models, and reliable material properties. With these tools, both durability analysis and damage tolerance analysis can be performed. All potentially critical locations were assumed to exhibit slow crack growth. No fail-safe concepts were used, although many locations have alternate load paths that carry the limit load. Author

N92-18594# Aeronautical Systems Div., Wright-Patterson AFB, OH. Structures Div.
MANAGING AIRBORNE ASSETS THROUGH LOADS MONITORING
R. Mach *In* AGARD, Fatigue Management Dec. 1991 12 p

(For primary document see N92-18571 09-05)
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Loads monitoring was a cornerstone of the Air Force Structural Integrity Program from its inception. But the high cost of new systems has provided a new need for the program. It provides the hard data that is required by the systems manager to determine the economic life of their aircraft and the most efficient allocation of aircraft to maintain optimum operation capability. Continued advances in solid state microprocessors and integrated software along with advances in storage media should enhance the capability of the overall program. Author

N92-18595# Aeronautical Systems Div., Wright-Patterson AFB, OH. Loads and Dynamics Branch.
APPROACH TO CREW TRAINING IN SUPPORT OF THE USAF AIRCRAFT STRUCTURAL INTEGRITY PROGRAM (ASIP)
Alfonso G. Aponte *In* AGARD, Fatigue Management Dec. 1991 7 p (For primary document see N92-18571 09-05)
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Maintaining the safety and strength of an aircraft is dependent upon the capability of appropriate Air Force commands to perform maintenance and inspections throughout the service life of the aircraft. One of the maintenance actions involves the collection and reporting of operational usage data to support the loads/environment spectra survey (L/ESS) and Individual Aircraft Tracking (IAT) programs. The Air Force approach to training operational flight and ground crews about their responsibilities and the importance of this task which is an integral part of the Aircraft Structural Integrity Program (ASIP) is presented. Author

N92-18778# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Fluid Dynamics Panel.
MANOEUVRING AERODYNAMICS
Nov. 1991 287 p In ENGLISH and FRENCH Meeting held in Toulouse, France, 1-2 May 1991
(AGARD-CP-497; ISBN-92-835-0643-X) Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

This volume contains the 17 papers presented at the Advisory group for Aerospace Research & Development (AGARD) Fluid Dynamics Panel (FDP) Specialists' Meeting on Maneuvering Aerodynamics. In addition to these papers, the general discussion held at the end of the meeting and the Technical Evaluation Report are included. This FDP sponsored meeting and document reflect the growing interests in rapid, large-amplitude aircraft maneuvers at high angles of attack and highlights the importance of the unsteady separated, vortical and often nonlinear characteristics of the aerodynamic flows that exist under such conditions. Developments in pertinent experimental techniques, relevant aerodynamic data and their applications to flight behavior predictions, importance of time lags, methods for forebody vortex control, and flight tests of the X-31A aircraft are among the topics discussed. For individual titles, see N92-18779 through N92-18795.

N92-18779# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Deutsche Aerospace/Military Div.
X-31 ENHANCEMENT OF AERODYNAMICS FOR MANEUVERING BEYOND STALL
Hannes Ross *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 12 p (For primary document see N92-18778 09-05)
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Current fighter aircraft are generally limited to angles of attack (AOA) below their maximum lift capability. Pilot inputs and aircraft maneuvering usually become limited when approaching the stall limited. Primary reasons for this situation are the degrading aerodynamic lateral/directional characteristics and reduced control power in the high AOA regime, often resulting in uncontrolled maneuvers/departures/spins. For these reasons, some aircraft reduced roll control inputs as well as Aileron-/Rudder-Interconnect (ARI) Systems installed to avoid uncoordinated flight conditions at higher AOA. Others have limitations as to the number of consecutive rolls they are allowed to fly even in the conventional AOA. Others have limitations as to the number of consecutive rolls that are allowed to fly even in the conventional AOA regime to prevent uncontrollable pitch-up/Beta excursions due to inertia coupling and engine gyroscopic moments. In the last ten years, new efforts have started to improve control capability in this flight regime. F-14, F-15, and F-18 have demonstrated AOA excursions up to about 65 degrees and the Su-27 and MIG-29 have performed impressive pitch maneuvers even exceeding AOA's of 90 degrees. However, all of the above mentioned maneuvers are performed in the pitch plane with little or no capability left for role control around the velocity vector. A number of experimental aircraft programs were initiated to explore the high AOA and the poststall regime to broaden the knowledge base. The flight test objectives range from basic understanding and investigation of aerodynamic flow phenomena (X-29, a/c no. 2 high AOA test vehicle, F-18 High AOA Research Vehicle (HARV)) to the incorporation of thrust vectoring capability (HARV) and finally to the demonstration of technical feasibility and tactical utility of high AOA maneuvering (X-31 A). Author

N92-18780*# Notre Dame Univ., IN. Dept. of Aerospace and Mechanical Engineering.
AERODYNAMIC AND FLOWFIELD HYSTERESIS OF SLENDER WING AIRCRAFT UNDERGOING LARGE-AMPLITUDE MOTIONS
Robert C. Nelson, Andrew S. Arena, Jr., and Scott A. Thompson *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 11 p (For primary document see N92-18778 09-05)
(Contract NCA2-406; NAG1-727; AF-AFOSR-0321-90)
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The implication of maneuvers through large angles of incidence is discussed by examining the unsteady aerodynamic loads, surface pressures, vortical position, and breakdown on slender, flat plate delta wings. Two examples of large amplitude unsteady motions are presented. First, the unsteady characteristics of a 70 degree swept delta wing undergoing pitch oscillation from 0 to 60 degrees is examined. Data is presented that shows the relationship between vortex breakdown and the overshoot and undershoot of the aerodynamic loads and surface pressure distribution. The second example examines the leading edge vortical flow over an 80 degree swept wing undergoing a limit cycle roll oscillation commonly called wing rock. Author

N92-18781# Alenia, Torino (Italy).
PREDICTION OF AERODYNAMIC PHENOMENA LIMITING AIRCRAFT MANOEUVRABILITY
A. Ferretti, A. Bartoli, and A. Salvatore *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 10 p (For primary document see N92-18778 09-05)
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The synthesis of recent experiences concerning the effects of shock induced separation on conventional airplanes flying at high subsonic speeds are presented. Efforts were concentrated in synthesizing a prediction criterion for detecting onset of the wing aerodynamic phenomena leading to buffet and mishandling of such airplanes. Comparison of mishandling and buffet onset envelopes theoretically derived with those experimentally measured on an airplane is given evidencing the consistency of the methodology. For nonconventional, highly swept wings featuring leading edge vortical flow at high subsonic speed and moderate angle of attack, the analysis of wind tunnel results has allowed the definition of a prediction criterion for transition from attached to vortical flow. This change in the wing flow structure is responsible for remarkable nonlinearities in the aerodynamic coefficients of the aircraft and could limit maneuverability in certain areas of the flight envelope. Efforts in implementing these concepts in the aerodynamic design

process of such wing planforms are stressed as well as the need for further studies concerning a deeper understanding of the fluid dynamic conditions ruling the vortex breakdown. Author

N92-18782# Aeronautica Macchi S.p.A., Varese (Italy). Aerodynamics Dept.
PARAMETRIC EFFECTS OF SOME AIRCRAFT COMPONENTS ON HIGH-ALPHA AERODYNAMIC CHARACTERISTICS
L. Visintini, R. Pertile, and A. Mentasti *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 11 p (For primary document see N92-18778 09-05)
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A wind tunnel test activity was performed with the purpose of defining and understanding the high angle of attack aerodynamic characteristics of an advanced trainer aircraft configuration. The tests included static and rotary balance measurements in the full 0 to 90 degree angle of attack range. The presentation includes a discussion of effects of model breakdown and of forebody finess ratio and cross section. Examples are also given about special difficulties related to subscale high angle of attack wind tunnel testing. Author

N92-18783# Wright Lab., Wright-Patterson AFB, OH.
NON-LINEAR AIRLOADS HYPERSURFACE REPRESENTATION: A TIME DOMAIN PERSPECTIVE **c02**
J. E. Jenkins and E. S. Hanff (National Aeronautical Establishment, Ottawa, Ontario) *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 9 p Sponsored in part by AFOSR and Dept. of National Defence (For primary document see N92-18778 09-05)
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Representation of nonlinear and unsteady airloads by the reaction hypersurface model is shown to be a special case of the nonlinear indicial response model. The principal requirement is that the motions are analytical (in the strict mathematical sense) to ensure uniqueness. Static and roll oscillation test data for a 65 deg delta wing at an angle of attack of 30 deg were analyzed using the theoretical relationships between the two models. Analysis results indicate that the existence of singularities in the static rolling moment variation with roll angle invalidate the current model. Additional experiments are planned to resolve this issue. Author

N92-18784# General Dynamics Corp., Fort Worth, TX.
ANALYSIS OF UNSTEADY FORCE, PRESSURE, AND FLOW-VISUALIZATION DATA FOR A PITCHING STRAKED WING MODEL AT HIGH ANGLES OF ATTACK
A. M. Cunningham, Jr. and R. G. denBoer *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 16 p Prepared in cooperation with National Aerospace Lab., Amsterdam, Netherlands (For primary document see N92-18778 09-05)
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Results are presented and discussed for the low speed test of a straked wing model oscillating in pitch that was conducted during 1986. The model was oscillated about mean angles of attack ranging from (-)4 deg to 48 deg with amplitudes varying from 2 deg to 18 deg for a maximum incidence range of (-)8 deg to 50 deg. It was also oscillated in pitch at side slip angles of (+)5 deg and (-)5 deg. Steady and unsteady pressure and flow-visualization data are used to provide a better understanding of the phenomena observed in the aerodynamic characteristics. Author

N92-18785# Royal Aerospace Establishment, Bedford (England). Aerodynamics Dept.
MEASUREMENT OF DERIVATIVES DUE TO ACCELERATION IN HEAVE AND SIDESLIP
C. O. OLeary, B. Weir, and J. M. Walker *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 11 p (For primary document see N92-18778 09-05)
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The paper describes the design of a new oscillatory rig, lightweight models, and tests in a low speed wind tunnel. Tests were made over a range of frequencies and model configurations. Derivatives due to acceleration in heave and sideslip, the alpha and beta first derivatives, have been measured for the two High Incidence Research Models (HIRM), HIRM1 and HIRM 2. Dynamic measurements were also made of the 'static' derivatives due to alpha and beta. Results showed that, at high angle-of-attack, derivatives due to acceleration in sideslip, in particular, are large and varied significantly with frequency of oscillation. Effects of model configuration are also presented. Dynamic effects on derivatives due to sideslip angle were significant. Author

N92-18786# Aeronautical Research Inst. of Sweden, Bromma.
WIND TUNNEL FORCE MEASUREMENTS AND VISUALIZATION ON A 60-DEG DELTA WING IN OSCILLATION, STEPWISE MOTION, AND GUSTS
Per-Ake Torlund *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 13 p (For primary document see N92-18778 09-05)
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A 60 deg delta wing has been tested in pitching motion in a low-speed wind tunnel. Harmonic oscillation tests with 4 and 8 deg amplitude at 0 to 35 deg angle of attack were carried out. The reduced frequency was between .003 and .195. Both dynamic aerodynamic derivatives and time histories of the normal force and pitching moment were recorded. The same model was also tested in a stepwise motion up to 90 deg angle of attack. The steps were positive and negative with 20 deg amplitude starting every 10 deg, also steps over the full 90 deg were made. The angle of attack rates were chosen to correspond to the oscillation tests, the maximum being 360 deg/s and the acceleration 13500 deg/s(exp 2). The tunnel speed was 57 m/s in most cases and the centerline chord was .5 m. The response to the step motion was compared to the response predicted from the results of the oscillation tests. Author

N92-18787# Institut de Mecanique des Fluides de Lille (France).
CHARACTERIZATION OF UNSTEADY AERODYNAMIC PHENOMENA AT HIGH ANGLES [CARACTERISATION DE PHENOMENES AERODYNAMIQUES INSTATIONNAIRES A GRANDE INCIDENCE]
O. Renier *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 21 p In FRENCH; ENGLISH summary (For primary document see N92-18778 09-05)
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Dynamic maneuvers of an aircraft at high angles of attack are known to be the origin of unsteady, large amplitude aerodynamic phenomena. These phenomena cannot be neglected if the control of aircraft attitudes and movements has to be optimized. Such unsteady effects can be characterized on specific wind tunnel test facilities. Already effects of large incidence and sideslip variations of various aircraft geometries have been measured on the IMFL rotary balance during oscillatory coning motions. They have been globally taken into account in mathematical models using transfer functions. An original test apparatus was set up in the IMFL low speed wind tunnel. Various dynamic pitch and/or yaw motions can be carried out on an aircraft model: sinusoidal or constant angular rate motions or typical pointing maneuver attitude evolution. The large performance of this apparatus allows the characterization and analysis of small and large amplitude, high angles of attack aerodynamic phenomena. Those test facilities are described, their dynamic simulation potentialities illustrated by some results and modelization techniques used are presented. Author

N92-18788# Aeronautical Research Labs., Melbourne (Australia).
SCALE MODEL MEASUREMENTS OF FIN BUFFET DUE TO VORTEX BURSTING ON F/A-18
C. A. Martin and D. H. Thompson *In* AGARD, Manoeuvring

Aerodynamics Nov. 1991 10 p (For primary document see N92-18778 09-05)
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Tests were carried out on scale models of the F-18 in a wind tunnel and in a water tunnel to study the characteristics of tail buffet due to bursting of the wing leading edge extension (LEX) vortices. The wind tunnel program covered the measurement of unsteady surface pressures and accelerations at the tail of a 1/9th scale model, for cases with and without the LEX fences fitted. Flow visualization of the vortex behavior was carried out using smoke and a laser light sheet. Extensive flow visualization tests were also carried out on a 1/4th scale model in a water tunnel to study the effects of engine intake flow and of the LEX fence on burst characteristics. Various aspects of these test programs are presented. Author

N92-18789# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
X-31: DISCUSSION OF STEADY STATE AND ROTARY DERIVATIVES
W. Kraus *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 32 p (For primary document see N92-18778 09-05)
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The X-31A high agility airplane was designed to operate with excellent aerodynamic qualities not only in the normal flight regime, but also at high angles of attack. The aircraft was designed to have natural aerodynamic stability about all three axis in the entire angle of attack range, except at small angle of attack, where the aircraft is unstable in pitch for performance reasons. In some critical regions in which the natural stability cannot be attained, the control power required to achieve stability is provided to the appropriate axis by artificial control, still leaving sufficient control power for maneuvers. In a basic wind tunnel development program, a configuration was tailored which fulfills most of the demanded requirements by aerodynamic means. Both the results and the method of obtaining these results is presented. Besides this static behavior, each aircraft has dynamic characteristics, which decide whether or not the aircraft will diverge. Additional wind tunnel tests was conducted in a spin tunnel to evaluate these characteristics. An analysis of the data is presented including steady state spin modes. Author

N92-18790# British Aerospace Public Ltd. Co., Preston (England). Military Aircraft Div.
USE OF STEPWISE REGRESSION TECHNIQUES AND KINEMATIC COMPATIBILITY FOR THE ANALYSIS OF EAP FLIGHT DATA
A. R. Perkins *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 12 p (For primary document see N92-18778 09-05)
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An investigation is described into the capabilities and accuracy of an equation error method of aerodynamic parameter identification using stepwise regression techniques. The results of the method are presented for flight responses of the British Aerospace EAP aircraft which has multiple control surfaces and high levels of longitudinal instability together with significant nonlinearities in the aerodynamic data. The benefit of kinematic compatibility processing of the flight data is also presented. The EAP flight responses are analyzed up to an incidence of 30 deg using a technique for joining together several maneuvers to form larger data bases for analysis. The derivatives extracted by these techniques agree in general with the results of the wind tunnel measurements. Author

N92-18791*# Eidetics International, Inc., Torrance, CA.
AERODYNAMIC CONTROL OF FIGHTER AIRCRAFT BY MANIPULATION OF FOREBODY VORTICES **c08**
Gerald N. Malcolm and T. Terry Ng *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 22 p (For primary document see N92-18778 09-05)
(Contracts NAS2-13155; F33615-86-C-3623)
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Methods of enhancing aircraft controllability and maneuverability at high angles of attack by manipulating the forebody vortices are discussed. Pneumatic control methods including jet blowing, slot blowing, and suction, and mechanical control methods using forebody and nose tip strakes are reviewed. The potential of various control devices in controlling the forebody flow, and thus, providing controlled yawing moments at high angles of attack are illustrated using wind tunnel results from a generic fighter and water tunnel results from an F/A-18. Author

N92-18792# Wright Lab., Wright-Patterson AFB, OH.
FOREBODY VORTEX CONTROL AEROMECHANICS **c08**
Robert W. Guyton, Russell F. Osborn, and Scott P. LeMay *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 14 p (For primary document see N92-18778 09-05)
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Forebody vortex flow characteristics are discussed in terms of the forebody flowfield aerodynamics and the impact of this flow on the resulting forces and moments that limit combat maneuverability. Test results are presented for several pneumatic forebody vortex control designs applied to a 1/8 scale X-29 model, a 1/15 scale F-16 model, and a 55 degree cropped delta/chined forebody model representative of future fighter configurations. Author

N92-18793# Royal Aerospace Establishment, Farnborough (England). Aerodynamics Dept.
DYNAMIC WIND TUNNEL TESTS ON CONTROL OF FOREBODY VORTICES WITH SUCTION **c08**
A. Jean Ross, E. B. Jefferies, and Geraldine F. Edwards *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 12 p (For primary document see N92-18778 09-05)
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Extensive static and dynamic experiments were made in low speed wind tunnels to investigate the possibility of using the yawing moment due to asymmetric forebody vortices for control at high angles of attack. The relative positions of the two vortices arising near the nose apex can be changed by applying differential suction through two small holes very near the tip. The resulting forces and moments measured in static tests were analyzed for the effects of forebody diameter and slenderness ratio. The Royal Aeronautical Establishment (RAE) High Incidence Research Model was controlled successfully on a free-to-yaw rig, indicating that the system could be used in flight. However, it could be expected that there are significant lags in the generation of the aerodynamic forces and moments. Experiments were conducted on a simple missile model mounted on a string rig, to measure the responses in yawing moment and sideforce due to sinusoidal variation over a range of frequencies of flow rates through suction holes. The implications of these results for the proposed free-flight model tests are discussed. Author

N92-18794# Dornier Luftfahrt G.m.b.H., Friedrichshafen (Germany, F.R.).
TRANSFORMATION OF FLIGHTMECHANICAL DESIGN REQUIREMENTS FOR MODERN FIGHTERS INTO AERODYNAMIC CHARACTERISTICS
Peter Mangold *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 15 p (For primary document see N92-18778 09-05)
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Recent experience in the design of highly augmented modern fighter aircraft with basically unstable characteristics in pitch have shown that the early integration of flightmechanical requirements into the aerodynamic optimization process is mandatory. Maximum allowable instabilities and control power requirements will set remarkable constraints to the freedom of aerodynamic design and

influence essential components of the aircraft. Because of the complex aerodynamic effects at high angles of attack, it will be necessary to approach the 'basic configuration' by some optimization loops. During the whole process, specialists from flight mechanics, aerodynamics, and overall design departments have to form a close team in order to end up with an excellent, well balanced design. It was proven that a set of criteria which represents a platform of common discussion for the specialist groups 'aerodynamics', 'flight mechanics', and control law designers' within early phases of a new fighter project can be and must be established in order to avoid unexpected, time consuming and costly difficulties in later design phases. Author

N92-18795# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
AEROSERVOELASTIC STABILITY OF AIRCRAFT AT HIGH INCIDENCE **c08**
Juergen Becker *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 20 p (For primary document see N92-18778 09-05)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The aeroservoelastic stability of a fighter type aircraft is investigated at high angle of attack. The effects of nonlinear, incidence dependent unsteady aerodynamic forces of elastic modes and of control surface deflections on the structural coupling are demonstrated for low and high subsonic speeds for different incidences. The difference of open loop frequency response functions calculated with linear and with high angle of attack unsteady aerodynamics documents the necessity of the introduction of high incidence effects for aeroservoelastic stability calculations. Nonlinear effects are introduced using unsteady pressures of wind tunnel experiments on an oscillating model by correction of theoretical pressures. Author

N92-18826# Diagnostic Equipment Development, Inc., Boca Raton, FL.
CH-46 AND OH-58 TRANSMISSION STRESS WAVE ANALYSIS Final Report
David B. Board 30 Dec. 1990 150 p
(Contract N62269-85-R-0278)
(AD-A244321; NADC-91069-60) Avail: NTIS HC/MF A07
CSCL 01/3

This report documents the results of testing on two types of helicopter transmissions. The analysis of high frequency stress wave data indicates various types of problems that were detected with gears and bearings in both CH-46 and OH-58 gear boxes. The types of discrepancies detected include shaft misalignment as a function of flight loads; planet gear/bearing assembly damage; sun gear damage; wear-in phenomena; and the presence of particulate debris in the lubrication system. GRA

06 AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments.

For related information see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

N92-18014# Aeronautical Systems Div., Wright-Patterson AFB, OH.
AN EVALUATION OF FOUR F-16 VERTICAL VELOCITY INDICATOR CONFIGURATIONS Final Report, Feb. - May 1990
Scott M. Cone and John A. Hassoun Nov. 1991 53 p
(AD-A243629; ASD-TR-91-5007) Avail: NTIS HC/MF A04
CSCL 14/2

Four different Vertical Velocity Indicator (VVI) configurations/mechanizations were evaluated in an F-16C simulator: (1) F-16C moving tape VVI; (2) electromechanical semicircular, moving pointer VVI; (3) liquid crystal, semicircular, moving pointer VVI; and (4) same as 3 with a faster response time. Configurations 1, 2, and 3 had the same dampening characteristics as are currently used in the F-16C; configuration 4 was included to assess the impact of VVI dampening on pilot performance. Ten pilots flew a series of rate climbs/descents and an Instrument Landing System approach and landing for each configuration. Pilot performance data showed a larger average pitch rate for the moving tape VVI, suggesting greater workload, and an improved ability to maintain a specified vertical velocity when using configuration 4. Subjective data showed that the moving tape was the least preferred of the four, especially for use in dynamic conditions. GRA

07 AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxilliary power plants for aircraft.

For related information see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels,* and *44 Energy Production and Conversion.*

N92-18230# Oak Ridge National Lab., TN.
FIBER-SENSOR DESIGN FOR TURBINE ENGINES
K. W. Tobin, Jr., D. L. Beshears, W. D. Turley, W. Lewis, III, and B. W. Noel (Los Alamos National Lab., NM.) Aug. 1991 10 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contracts DE-AC05-84OR-21400; W-7405-eng-36)
(DE92-003539; CONF-9109230-7) Avail: NTIS HC/MF A02

Determination of blade temperatures in the high speed and turbulent environment of a turbine engine is difficult using standard pyrometry techniques because of the presence of high temperature flame and the reflective nature of the inspection surfaces. A technique utilizing thermographic phosphor compounds bonded to engine vanes and turbine blades is presented that mitigates the negative effects of blackbody radiation while potentially allowing near real time acquisition of blade temperature information. Specialized single and dual fiber optic probes were designed to interrogate both fixed and rotating surfaces by delivering ultraviolet light from a quadrupled Nd:YAG (266 nm) laser to phosphor coatings consisting of Y2O3:Eu, YVO4:Eu, and YAG:Tb ceramic compound. This technique utilizes the temperature dependent fluorescent emission of a ceramic phosphor coating to discern the temperature of the interrogated surface. By using these methods, surface temperature measurements to 1200 C are achievable in the combustion environment. DOE

N92-18728# Cranfield Inst. of Tech., Bedford (England). School of Mechanical Engineering.
ADVANCED TACTICAL FIGHTER ENGINE M.S. Thesis
R. Davis Sep. 1990 192 p Sponsored by Ministry of Defence Procurement Executive
(ETN-92-90840) Copyright Avail: NTIS HC/MF A09

The design of an aeroengine suitable to power the Advanced Tactical Fighter (ATF), a supersonic, long range tactical fighter aircraft being developed in the U.S. is detailed. The specification for a similar long range fighter was used to provide the engine specification. Both turbojet and turbofan cycles were fully investigated at design point, and off design, before selecting the turbofan cycle for further study and optimization. Having optimized the turbofan cycle, the design of the cycle as an aft fan and the design of a conventional turbofan were investigated and the two designs were compared and contrasted. The suitability of the aft fan as a powerplant for the ATF was assessed. ESA

N92-18867# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
OPTIMIZATION OF TANGENTIAL MASS INJECTION FOR MINIMIZING FLOW SEPARATION IN A SCRAMJET INLET M.S. Thesis
Richard J. Kacik Dec. 1991 294 p
(AD-A243868; AFIT/GAE/ENY/91D-2) Avail: NTIS HC/MF A13
CSCL 21/5

With the reemergence of interest in air-breathing hypersonic

propulsion, scramjet inlet efficiency has become an area of concern. The impingement of the engine cowl shock near the shoulder (expansion corner between forebody and combustor) may cause boundary layer separation which reduces inlet efficiency. Tangential mass injection (TMI) upstream of the shoulder has recently been tested to control this separation but without much parametric evaluation. To resolve this deficiency, a 2-D scramjet inlet model with variable length cowl, and TMI was built and tested in the WL Mach 6 High Reynolds Number Facility. Parameters varied were boundary layer thickness, TMI flow rate, cowl position, cowl and shoulder angle, and slot to shoulder distance. The optimum slot location was determined by finding the minimum injection flow rate required to eliminate separation for each configuration and analyzing the trends. The test results, along with a simplified mixing theory based on maximizing the jet/freestream wake mass flux, indicated that the optimum slot location was 5-6 slot heights upstream of the shoulder. However, this result was somewhat obscured by the observation that, when the cowl shock impinged closer to (but downstream of) the slot or aft of the shoulder, less mass injection was required to eliminate separation. A typical TMI rate for controlling the shock-induced separation in these regions was 3-6 percent of the inlet captured mass flow. GRA

08 AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots.

For related information see also *05 Aircraft Design, Testing and Performance.*

N92-18294# Manchester Univ. (England). Aeronautical Engineering Group.
MODEL PARAMETER IDENTIFICATION TECHNIQUES FOR FLIGHT FLUTTER TESTING
J. E. Cooper 1991 30 p Presented at 71st AGARD Structures and Materials Panel, Povoa de Varzin, Portugal, 8-10 Oct. 1990
(Aero-Rept-9105; ETN-92-90936) Avail: NTIS HC/MF A03

The most popular modal parameter identification techniques and the comparative exercises involving them are reviewed. A survey of the application of such methods in flight flutter tests is undertaken. A survey and some form of round robin procedure are deemed necessary in order to establish the effective use of system identification techniques for flight flutter testing. ESA

N92-18321# Manchester Univ. (England). Aeronautical Engineering Group.
AIRCRAFT AERODYNAMICS AND STABILITY AND CONTROL DURING AIR-TO-AIR REFUELING Ph.D. Thesis
Vassilios Trochalidis May 1990 140 p Sponsored by Science Research Council and Ministry of Defence
(Aero-Rept-9017; ETN-92-90940) Avail: NTIS HC/MF A07

A study aimed at the development of an analytical model capable of representing any combination of tanker and receiver aircraft in an Air to Air Refueling (AAR) configuration is presented. A theoretical analysis of the problem with requirements for theoretical models is given. Individual theories such as lifting line, horseshoe vortex, and vortex lattice method are given. Combination models are discussed. The experimental hardware and software is described. Experimental tests are described and measurements are plotted and compared with theoretical predictions. The longitudinal aerodynamic interference between large receiver and radar aircraft during AAR is addressed. Results from an investigation into the lateral aerodynamics and stability and control of a VC10/Hercules tanker/receiver combination are presented. ESA

N92-18893# National Aerospace Lab., Amsterdam (Netherlands). Flight Div.
DEVELOPMENT OF NONLINEAR REAL-TIME HELICOPTER SIMULATION USING A BLADE ELEMENT METHOD
W. Brouwer and L. Meerwijk 31 Mar. 1990 27 p Presented at the Royal Aeronautical Society Conference on Progress in Helicopter and V/STOL Aircraft Simulation, London, England, 1-2 May 1990
(NLR-TP-90115-U; ETN-92-90969) Avail: NTIS HC/MF A03

The background of a program focused on extending its moving base research flight simulator facility with real time helicopter simulation, and its objectives and the approach to accomplish them are discussed. The available hardware systems (e.g., a multiprocessor computer system, a model board/television camera visual system, and motions systems) in combination with the development software contain sufficient capabilities to establish a helicopter research facility for research concerning handling qualities, digital control laws, man machine interface, etc. The procurements expected in the near future, a generic helicopter cockpit and a computer generated imagery visual system, will not only support but also increase these capabilities. Specific helicopter software modules ware developed and tested separately. At present, the modules are integrated within the comprehensive flight simulation program and off line validation are in progress. The helicopter software modules developed are outlined and suggestions for further improvements are given. ESA

N92-18791*# Eidetics International, Inc., Torrance, CA.
AERODYNAMIC CONTROL OF FIGHTER AIRCRAFT BY MANIPULATION OF FOREBODY VORTICES
Gerald N. Malcolm and T. Terry Ng *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 22 p (For primary document see N92-18778 09-05)
(Contracts NAS2-13155; F33615-86-C-3623)
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N92-18792# Wright Lab., Wright-Patterson AFB, OH.
FOREBODY VORTEX CONTROL AEROMECHANICS
Robert W. Guyton, Russell F. Osborn, and Scott P. LeMay *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 14 p (For primary document see N92-18778 09-05)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-18793# Royal Aerospace Establishment, Farnborough (England). Aerodynamics Dept.
DYNAMIC WIND TUNNEL TESTS ON CONTROL OF FOREBODY VORTICES WITH SUCTION
A. Jean Ross, E. B. Jefferies, and Geraldine F. Edwards *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 12 p (For primary document see N92-18778 09-05)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-18795# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.).
AEROSERVOELASTIC STABILITY OF AIRCRAFT AT HIGH INCIDENCE
Juergen Becker *In* AGARD, Manoeuvring Aerodynamics Nov. 1991 20 p (For primary document see N92-18778 09-05)
Copyright Avail: NTIS HC/MF A13; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

09 RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands.

For related information see also *14 Ground Support Systems and Facilities (Space).*

N92-18012# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.

AN APPLICATION OF THE OBJECT-ORIENTED PARADIGM TO A FLIGHT SIMULATOR M.S. Thesis

Dennis J. Simpson Dec. 1991 203 p

(AD-A243624; AFIT/GCS/ENG/91D-22) Avail: NTIS HC/MF A10 CSCL 12/5

This thesis describes the object-oriented software development techniques that were used to analyze, design and implement a flight simulator. The objective of this thesis was to present a comprehensive object-oriented software development methodology and show how it was used in constructing an actual application. An extensive review of current object-oriented practices is presented along with the methods that were used to take the flight simulator from analysis to design and through to implementation. The description of the methodology concentrates upon the design and implementation phases of the object-oriented software lifecycle. Examples from the design of the flight simulator demonstrate how each phase of the methodology was applied. The thesis includes insights on how to use the C++ language in implementing an object-oriented design and how to fold procedurally oriented code into an object-oriented framework.

GRA

N92-18037# National Aerospace Lab., Tokyo (Japan). Computational Sciences Div.

ULTRA HIGH SPEED NUMERICAL WIND TUNNEL (UHSNWT) INITIATIVE AT NATIONAL AEROSPACE LABORATORY NUMERICAL SIMULATOR - SECOND GENERATION

Hajime Miyoshi May 1991 31 p In JAPANESE; ENGLISH summary

(NAL-TR-1108; ISSN-0389-4010) Avail: NTIS HC/MF A03

In order to promote computational fluid dynamics (CFD) research activities and effectively apply their results in the research and development of future aircraft and space planes, it is necessary to develop within the next two or three years a CFD-oriented computer (ultra high-speed numerical wind tunnel/UHSNWT) whose CFD processing speed is more than 100 times higher than the currently used Fujitsu VP400, and also to subsequently develop a computer more than 1000 times faster by the end of 1990's. The requirements for the UHSNWT are discussed from a perspective of development and operation costs, reliability, affinity with CFD programs, and operation environment. In addition, a National Aerospace Laboratory (NAL) UHSNWT initiative is proposed based on the following: (1) vector computer operational; (2) program processing software simulation for several vector computer configurations; and (3) future trend forecasts of Large-Scale Integrated Circuit (LSI) technology. It is concluded that developing the UHSNWT with a performance of more than 100 times higher than the VP400 is feasible using a parallel computer having a distributed memory and crossbar network.

Author

N92-18069# Oak Ridge National Lab., TN.

ULTRA-HIGH TEMPERATURE (GREATER THAN 2000 C) TESTING CAPABILITY AT OAK RIDGE NATIONAL LABORATORY FOR CARBON MATERIALS IN AIR, INERT GAS AND VACUUM

R. L. Huddleston and D. G. OConnor 1991 12 p Presented at the International Symposium on Ultra-High Temperature Materials, Jajimi City, Japan, 7 Dec. 1991

(Contract DE-AC05-84OR-21400)

(DE92-004445; CONF-911272-1) Avail: NTIS HC/MF A03

A new ultra-high temperature multiaxial (axial-torsional) test system concept is being developed for the testing of carbon-carbon composite materials at temperatures up to 2200 C in air, argon, and vacuum. The basic system concept incorporates computer control of temperature, pressure, and strain, displacement, or load versus time such that one can either test materials in the conventional monotonic or cyclic mode or 'fly a temperature-pressure-stress vs time profile' to simulate a vehicle trajectory from ground level to space or vice versa. A unique spherical hydrostatic bearing concept is being developed which should permit the system to transmit both axial and torsional loadings with low induced bending moments. The basic test system has been assembled and shakedown tests of ATJ graphite specimens have been conducted at temperatures up to 1910 C.

DOE

N92-18290# Sandia National Labs., Albuquerque, NM.

COMBINED VISAR AND FLASH X RAY TESTING TECHNIQUES

D. H. Sanchez, J. C. Lanoue, and G. A. Lare (Ktech Corp., Albuquerque, NM.) 1991 11 p Presented at the 16th Annual Joint Firing Set Conference, Livermore, CA, 15-17 Oct. 1991

(Contract DE-AC04-76DP-00789)

(DE92-004732; SAND-91-2376C; CONF-9110282-2-Vugraphs) Avail: NTIS HC/MF A03

We have developed an experimental facility that provides simultaneous imaging of flyer plates with measurement of flyer velocity. This system allows us to test both explosive and electrically-driven flyers over a temperature range of -54 to +74 C. Our Velocity Interferometer System for Any Reflector (VISAR) is capable of measuring flyer velocities from 0.5 to 6 nm/microns. The flash x-ray system allows recording images of flyers with a minimum thickness of 0.05 mm and a minimum diameter of 0.002 inches.

DOE

N92-18341# Manchester Univ. (England). Aeronautical Engineering Group.

THE INSTALLATION OF THE AVRO 9 BY 7 FOOT LOW-SPEED WIND TUNNEL AT THE UNIVERSITY OF MANCHESTER (ENGLAND)

D. I. A. Poll 1990 16 p

(Grant GRF/58646)

(Aero-Rept-9005; ETN-92-90922) Avail: NTIS HC/MF A03

The acquisition of the low speed tunnel, a university based facility having potential for fundamental high Reynolds number research in fluid dynamics, is described. The basic layout and leading dimensions of the tunnel are shown. The tunnel is of the closed return type which means that the power consumption for a given test speed is low. The principal design features and quoted performance figures are given. The move to the Goldstein Aeronautical Engineering Laboratory (north west of Manchester) is described.

ESA

N92-18415# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.

NLR EXPERIENCE WITH HIGH VELOCITY BURNER RIG TESTING, 1979-1989

R. J. H. Wanhill, A. J. A. Mom, H. J. C. Hersbach, G. A. Kool, and J. A. M. Boogers 28 Apr. 1989 33 p Submitted for publication

(NLR-TP-89152-U; ETN-92-90958) Avail: NTIS HC/MF A03

A large, custom built rig was commissioned in 1977 to enable actual components to be tested. A smaller rig for specimen testing was purchased in 1986. Experience of two high velocity burner rigs for oxidation and hot corrosion testing over the last decade is reviewed.

ESA

N92-18416# National Aerospace Lab., Amsterdam (Netherlands). Fluid Dynamics Div.

MODEL INCIDENCE MEASUREMENT USING SAAB ELOPTOPOS SYSTEM

P. H. Fuykschot 23 May 1989 8 p Presented at the 13th International Congress on Instrumentation in Aerospace Simulation

Facilities, Goetigen, Fed. Republic of Germany, 18-21 Sep. 1989
(NLR-TP-89182-U; ETN-92-90959) Avail: NTIS HC/MF A02

For measuring the angle of attack of models in a transonic windtunnel, a SAAB ELOPTOPOS system was acquired. The system consists of two infrared Light Emitting Diodes (LEDs) mounted fore and aft in the fuselage of the model, two linear array Charged Coupled Device (CCD) cameras, and special processors. The cameras are mounted to the sidewall of the windtunnel and have a viewing angle of 60 deg in the vertical direction. Thanks to a special optimizing algorithm, the camera resolution is enhanced to 0.001 deg. At a viewing distance of one meter, the resulting resolution in angle of attack of the model is typically 0.0026 deg. The system is individually calibrated for each mode under wind off conditions, using an extremely accurate gravity sensing inclinometer as a reference. This procedure ensures the required accuracy of 0.01 deg in angle of attack under wind on conditions. ESA

N92-18956*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
A USER'S GUIDE TO THE LANGLEY 16- BY 24-INCH WATER TUNNEL
Odis C. Pendergraft, Jr., Dan H. Neuhart, and Timmy T. Kariya (Vigyan Research Associates, Inc., Hampton, VA.) Jan. 1992 127 p
(NASA-TM-104200; NAS 1.15:104200) Avail: NTIS HC/MF A07 CSCL 14B

The Langley 16 x 24 inch Water Tunnel is described in detail, along with all the supporting equipment used in its operation as a flow visualization test facility. These include the laser and incandescent lighting systems; and the photographic, video, and laser fluorescence anemometer systems used to make permanent records of the test results. This facility is a closed return water tunnel capable of test section velocities from 0 to 0.75 feet per second with flow through the 16 x 24 inch test section in a downward (vertical) direction. The velocity normally used for testing is 0.25 feet per second where the most uniform flow occurs, and is slow enough to easily observe flow phenomena such as vortex flow with the unaided eye. An overview is given of the operational characteristics, procedures, and capabilities of the water tunnel to potential users of the facility so that they may determine if the facility meets their needs for a planned study. Author

12 ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see *91 Lunar and Planetary Exploration.*

N92-18054*# National Academy of Sciences - National Research Council, Washington, DC. Commission on Physical Sciences, Mathematics, and Applications.
SETTING PRIORITIES FOR SPACE RESEARCH: OPPORTUNITIES AND IMPERATIVES
1992 75 p Original contains color illustrations
(Contract NASw-4627)
(NASA-CR-189887; NAS 1.26:189887) Avail: NTIS HC/MF A04; 2 functional color pages CSCL 22A

Discussed here is the first phase of a study by a task group convened by the Space Studies Board to ascertain whether it should attempt to develop a methodology for recommending priorities among the various initiatives in space research (that is, scientific activities concerned with phenomena in space or utilizing observations from space). It is argued that such priority statements by the space research community are both necessary and desirable and would contribute to the formulation and implementation of public policy. The establishment of priorities to enhance effective management of the nation's scientific research program in space is advocated. It is argued that scientific objectives and purposes should determine how and under what circumstances research should be done. Author

N92-18304*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PIONEERING SPACE EXPLORATION: THE JSC STRATEGY
1992 35 p
(NASA-TM-105503; NAS 1.15:105503) Avail: NTIS HC/MF A03 CSCL 22A

The framework that JCS's senior management will use to guide effective decision making to achieve our long-rang goals while soliciting inputs from all levels of JSC is presented. This plan was developed to allow us to meet head-on the responsibilities and challenges we have today while assuring that we are well prepared to meet the opportunities and challenges of tomorrow. The JSC strategy is closely aligned with the overall strategic direction currently being defined by NASA. One of our major goals was to keep our plan and process tightly focused but flexible enough so that as our national interests in space exploration evolve, so can JSC. Author

13 ASTRODYNAMICS

Includes powered and free-flight trajectories; and orbital and launching dynamics.

N92-18944# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
NAVIGATION OF A SATELLITE CLUSTER WITH REALISTIC DYNAMICS M.S. Thesis
J. T. Middendorf Dec. 1991 68 p
(AD-A243897; AFIT/GA/ENY/91D-5) Avail: NTIS HC/MF A04 CSCL 17/7

Previous work in the area of estimation of relative positions within a satellite cluster showed favorable results. However, the work was done using point mass orbits in the truth model. This thesis investigates the estimation of relative satellite positions operating in near circular orbit including the J sub 2 term in Earth's geopotential. The iterated, extended Kalman filter is used as the on-board estimator in order to gain better performance in the face of the non-linearities. The dynamics in the estimator are based on the Clohessy-Wiltshire equations for relative orbital motion. Inputs to the host estimator are range measurements from each satellite in the cluster. The relative position to the host satellite is investigated. A comparison of the true error and the rms covariance was performed. GRA

N92-18831*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMMON LUNAR LANDER (CLL) TRAJECTORY ANALYSIS
Lynn A. Wagner, Jr. and Nancy A. Wilks *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 8 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22A

N92-18832*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
BASELINE ELVs: DELTA 2 7920 AND TITAN 2S SLV
In its Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 11 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22A

14 GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators.

For related information see also *09 Research and Support Facilities (Air).*

N92-18286*# Mississippi State Univ., Mississippi State. Dept. of Electrical and Computer Engineering.
AN INVESTIGATION OF NETWORKING TECHNIQUES FOR THE ASRM FACILITY Final Report, 6 Feb. 1991 - 5 Feb. 1992
Robert J. Moorhead, II, Wayne D. Smith, and Dale R. Thompson 4 Feb. 1992 57 p
(Grant NAG8-866)
(NASA-CR-189851; NAS 1.26:189851) Avail: NTIS HC/MF A04 CSCL 14B

This report is based on the early design concepts for a communications network for the Advanced Solid Rocket Motor (ASRM) facility being built at Yellow Creek near Iuka, MS. The investigators have participated in the early design concepts and in the evaluation of the initial concepts. The continuing system design effort and any modification of the plan will require a careful evaluation of the required bandwidth of the network, the capabilities of the protocol, and the requirements of the controllers and computers on the network. The overall network, which is heterogeneous in protocol and bandwidth, is being modeled, analyzed, simulated, and tested to obtain some degree of confidence in its performance capabilities and in its performance under nominal and heavy loads. The results of the proposed work should have an impact on the design and operation of the ASRM facility. Author

N92-18870# Wisconsin Univ., Madison. Engine Research Center.
CENTER FOR ADVANCED PROPULSION (EQUIPMENT) Final Report, 1 Sep. 1986 - 30 Jun. 1991
G. L. Borman 15 Aug. 1991 7 p
(Contract DAAL03-86-G-0199)
(AD-A244387; ARO-24624.92-EG-UIE) Avail: NTIS HC/MF A02 CSCL 14/2

This grant provided funds for purchase of equipment to be used for funded projects. These projects were to accomplish two major objectives of the Engine Research Center: (1) to produce research results which would help the Army in its quest for more efficient, higher power density engines, and (2) train students who could use the most advanced research technologies in their future work. The major categories of equipment needed for such research are: engines, data acquisition systems, emissions analysis instruments, shop facilities, computers, lasers, and a variety of special purpose instruments and special purpose rigs. GRA

15 LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles.

For related information see also *20 Spacecraft Propulsion and Power.*

N92-18203 Department of the Navy, Washington, DC.
EARLY BALLISTIC MISSILE DETECTION SYSTEM Patent
Bernard V. Kessler, inventor (to Navy) 1 Oct. 1991 4 p Filed 13 Sep. 1973
(AD-D015126; US-Patent-5,053,622; US-Patent-Appl-SN-398296; US-Patent-Class-250-358.1) Avail: US Patent and Trademark Office CSCL 17/5

A device for the optical detection of ballistic missiles is described. The invention uses satellites that emit beams of neutral molecules in a specified direction. Intense optical radiation will reflect off of the insulated surfaces of the nose cones. GRA

N92-18204 Department of the Navy, Washington, DC.
MISSILE ORIENTATION MONITOR Patent
Leonard S. Taylor, inventor (to Navy) and Bernard V. Kessler, inventor (to Navy) 13 Aug. 1991 7 p Filed 1 Jul. 1982
(AD-D015128; US-Patent-5,039,029; US-Patent-Appl-SN-398153; US-Patent-Class-244-3.11) Avail: US Patent and Trademark Office CSCL 17/9

A monitor determines, from the ground, the orientation (roll and attitude) of a missile by observation of the character of a signal transmitted from the ground. By transmitting to a ground receiver a linearly polarized signal, the missile identifies a given plane fixed with respect to its structure. This plane is identified at the ground receiver by comparing the ratio of the signals received in any two cross-polarized directions. To resolve the attendant 180 deg ambiguity, the monitor employs an antenna array attached to the missile that is switchable, back and forth, between two equal power lobes. The monitor operates with a single transmitter, and the simple lobe structure of the transmitted signal is obtained using a linearly polarized antenna array with electronic phase switching between the aforementioned equal power lobes. GRA

16 SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques.

For related information see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance.* For space suits see *54 Man/System Technology and Life Support.*

No abstracts in this category.

17 SPACE COMM., SPACECRAFT COMM., COMMAND & TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout.

For related information see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

N92-18307*# New Mexico State Univ., Las Cruces. Electrical and Computer Engineering.
TELEMETRY DOWNLINK INTERFACES AND LEVEL-ZERO PROCESSING Final Report, 1 Oct. 1988 - 30 Sep. 1991
S. Horan, J. Pfeiffer, and J. Taylor 1 Oct. 1991 144 p
(Contract NCC5-40)
(NASA-CR-188486; NAS 1.26:188486) Avail: NTIS HC/MF A07 CSCL 09F

The technical areas being investigated are as follows: (1) processing of space to ground data frames; (2) parallel architecture performance studies; and (3) parallel programming techniques. Additionally, the University administrative details and the technical liaison between New Mexico State University and Goddard Space Flight Center are addressed. Author

N92-18342*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTICHANNEL DEMULTIPLEXER/DEMODULATOR TECHNOLOGIES FOR FUTURE SATELLITE COMMUNICATION SYSTEMS
William D. Ivancic, James M. Budinger, Edward J. Staples, Irwin Abramovitz, and Hector A. Courtois (TRW Electronic Systems Group, Redondo Beach, CA.) 1992 9 p Proposed for presentation at the Ninth International Conference on Digital Satellite Communications, Copenhagen, Denmark, 18-22 May 1992; sponsored by Intelsat and Telecom Denmark
(NASA-TM-105377; E-6765; NAS 1.15:105377) Avail: NTIS HC/MF A02 CSCL 17B

NASA-Lewis' Space Electronics Div. supports ongoing research in advanced satellite communication architectures, onboard processing, and technology development. Recent studies indicate that meshed VSAT (very small aperture terminal) satellite communication networks using FDMA (frequency division multiple access) uplinks and TDMA (time division multiplexed) downlinks are required to meet future communication needs. One of the critical advancements in such a satellite communication network is the multichannel demultiplexer/demodulator (MCDD). The progress is described which was made in MCDD development using either acousto-optical, optical, or digital technologies.
Author

18 SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls.

For life support systems see *54 Man/System Technology and Life Support.* For related information see also *05 Aircraft Design, Testing and Performance, 39 Structural Mechanics,* and *16 Space Transportation.*

N92-18023*# San Francisco Univ., CA.
IONIZING RADIATION EXPOSURE OF LDEF
E. V. Benton, ed. and W. Heinrich, ed. (Siegen Univ.,, Germany, F.R.) Aug. 1990 66 p
(Grant NAG8-138)
(NASA-CR-189536; NAS 1.26:189536; USF-TR-77) Avail: NTIS HC/MF A04 CSCL 22B

The Long Duration Exposure Facility (LDEF) was launched into orbit by the Space Shuttle 'Challenger' mission 41C on 6 April 1984 and was deployed on 8 April 1984. The original altitude of the circular orbit was 258.5 nautical miles (479 km) with the orbital inclination being 28.5 degrees. The 21,500 lb NASA Langley Research Center satellite, having dimensions of some 30x14 ft was one of the largest payloads ever deployed by the Space Shuttle. LDEF carried 57 major experiments and remained in orbit five years and nine months (completing 32,422 orbits). It was retrieved by the Shuttle 'Columbia' on January 11, 1990. By that time, the LDEF orbit had decayed to the altitude of 175 nm (324 km). The experiments were mounted around the periphery of the LDEF on 86 trays and involved the representation of more than 200 investigators, 33 private companies, 21 universities, seven NASA centers, nine Department of Defense laboratories and eight foreign countries. The experiments covered a wide range of disciplines including basic science, electronics, optics, materials, structures, power and propulsion. The data contained in the LDEF mission represents an invaluable asset and one which is not likely to be duplicated in the foreseeable future. The data and the subsequent knowledge which will evolve from the analysis of the LDEF experiments will have a very important bearing on the design and construction of the Space Station Freedom and indeed on other long-term, near-earth orbital space missions. A list of the LDEF experiments according to experiment category and sponsor is given, as well as a list of experiments containing radiation detectors on LDEF including the LDEF experiment number, the title of the experiment, the principal investigator, and the type of radiation detectors carried by the specific experiment. Author

N92-18049*# Contel Federal Systems, Inc., Chantilly, VA.
FULL SERVICE ISDN SATELLITE (FSIS) NETWORK MODEL FOR ADVANCED ISDN SATELLITE DESIGN AND EXPERIMENTS Report, 25 Sep. 1990 - 1 Mar. 1992
Gerard R. Pepin 1 Mar. 1992 39 p
(Contract NASw-4520)
(NASA-CR-186569; NAS 1.26:186569) Avail: NTIS HC/MF A03 CSCL 22B

The Full Service Integrated Services Digital Network (FSIS) network model for advanced satellite designs describes a model suitable for discrete event simulations. A top down model design uses the Advanced Communications Technology Satellite (ACTS) as its basis. The ACTS and the Interim Service ISDN Satellite (ISIS) perform ISDN protocol analyses and switching decisions in the terrestrial domain, whereas FSIS makes all its analyses and decisions on-board the ISDN satellite. Author

N92-18114*# Contel Federal Systems, Inc., Chantilly, VA.
SCENARIOS AND PERFORMANCE MEASURES FOR ADVANCED ISDN SATELLITE DESIGN AND EXPERIMENTS Update Report
Gerard R. Pepin 28 Feb. 1991 45 p
(Contract NASw-4520)
(NASA-CR-187329; NAS 1.26:187329) Avail: NTIS HC/MF A03 CSCL 22B

Described here are the contemplated input and expected output for the Interim Service Integrated Services Digital Network (ISDN) Satellite (ISIS) and Full Service ISDN Satellite (FSIS) Models. The discrete event simulations of these models are presented with specific scenarios that stress ISDN satellite parameters. Performance measure criteria are presented for evaluating the advanced ISDN communication satellite designs of the NASA Satellite Communications Research (SCAR) Program. Author

N92-18119*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COBE ON-ORBIT ENGINEERING PERFORMANCE, VOLUME 1
1990 321 p Meeting held in Greenbelt, MD, 7-8 Mar. 1990
(NASA-TM-104959; NAS 1.15:104959) Avail: NTIS HC/MF A14 CSCL 22B

The Cosmic Background Explorer (COBE) was successfully launched on Nov. 18, 1989. The Delta Launch Vehicle performed flawlessly, and observatory deployments occurred as planned. The dewar cover successfully deployed on day 4, as planned, and the cryogen temperature is currently at 1.41 K. All three instruments are operating and acquiring science data, and the Payload Operational Control Center (POCC)/Network support has been excellent. Various performance aspects of the COBE are presented in view graph form. Author

N92-18241# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.
DAMPING ENHANCEMENT OF LARGE SPACE STRUCTURES BY PROOF-MASS-ACTUATORS
Takashi Kida, Isao Yamaguchi, Seiya Ueno, and Masaki Tanaka (Toshiba Corp., Tokyo, Japan) May 1991 23 p In JAPANESE; ENGLISH summary
(NAL-TR-1114; ISSN-0389-4010) Avail: NTIS HC/MF A03

The enhancement of modal damping is a key technology in Large Space Structures (LSS) robust control. A controller design is examined which actively augments substantial damping factors to LSS. The stability analysis of the closed loop system is discussed, and was subsequently confirmed by a ground based control experiment which used a newly developed pivoted type Proof Mass Actuator (PMA). The controller uses a direct velocity feedback control. A multi-input multi-output control system was examined using two PMAs, in addition to the single-input single-output case. In both cases, the experimental results showed excellent vibration suppression capability. A sizing problem of the PMAs is also discussed. Author

N92-18270*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
METEOROID AND DEBRIS IMPACT FEATURES DOCUMENTED ON THE LONG DURATION EXPOSURE FACILITY: A PRELIMINARY REPORT
T. See, comp., M. Allbrooks, comp., D. Atkinson, comp., C. Simon, comp. (Washington Univ., Saint Louis, MO.), and M. Zolensky, comp. Aug. 1990 583 p
(NASA-TM-105463; Publ-84; JSC-24608; NAS 1.15:105463)
Avail: NTIS HC/MF A25 CSCL 22B

The Long Duration Exposure Facility (LDEF) was host to several individual experiments designed to characterize aspects of the meteoroid and space-debris environment in low-Earth orbit. It was

realized from the very start, however, that the most complete way to accomplish this goal was to exploit the meteoroid and debris record of the entire LDEF. The Meteoroid and Debris Special Investigation Group (M&D SIG) was organized to achieve this end. Two dominant goals of the M&D SIG are the documentation of the impact record of the entire LDEF, and the dissemination of this information to all interested workers. As a major step towards the accomplishment of these goals, we have prepared this publication describing the M&D SIG observations of impact features made during LDEF deintegration activities at KSC in the spring of 1990. It is hoped that this report will serve as a useful guide for spacecraft designers as well as for meteoroid and space-debris workers, and that it will spur further work on the LDEF impact-laden surfaces collected by the M&D SIG and now available for allocation to qualified investigators. An important aim is to present all data and descriptions of impact features in a form which, though terse, remains comprehensible to the wider community. There is a deliberate minimum of interpretations. Thus, this catalog is intended to serve as a guide to the impact features found on LDEF and is not intended to stand as a definitive interpretive work. Author

N92-18299# Virginia Polytechnic Inst. and State Univ., Blacksburg.

ON-ORBIT STRUCTURAL DYNAMIC PERFORMANCE OF A LARGE-DIAMETER ANTENNA M.S. Thesis

Deborah M. Wahls Jun. 1991 99 p

Avail: NTIS HC/MF A05

An analysis of the structural vibrational performance of a 15-meter-diameter antenna subject to representative onboard dynamic disturbances is presented. Antenna performance parameter limits are defined for the root-mean-square surface roughness, pointing error, and defocus. The antenna concept is described, and the generation of the finite-element model is explained. A subreflector scanning scenario which represents an onboard disturbance to the system is modeled with orthogonal excitation functions. A modal analysis performed on the antenna in both free-flying and platform-mounted configurations is discussed. The resulting mode shapes and natural frequencies are then input to a forced-response analysis, which is performed for each configuration with the onboard scanning disturbance. The impact of the resulting dynamic distortions on the antenna performance parameters (i.e., errors) is assessed. The distortions in the surface are determined to contribute to all three errors, the displacement of the subreflector adds to the pointing error and defocus, and the displacement of the vertex is a component of the defocus. Based on the results of the analysis, the reflector support structure and feed mast of the low-frequency microwave radiometer as designed are capable of maintaining their shapes within specifications for the assumed on-orbit disturbance. This is particularly true for the platform-mounted configuration which exhibits errors within their respective limits by at least an order of magnitude. This is also true for the free-flyer configuration surface roughness and defocus; however, the free-flyer configuration maximum pointing error is significantly closer to, yet still within, its specified limit. Author

N92-18469# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

APPLICATION OF SELF-TUNING CONTROLLERS TO A REMOTE SENSING SATELLITE ATTITUDE CONTROL SYSTEM

Antonio Felix Martin Neto and Orlando Sanches Padilha Jun. 1991 8 p Presented at the Intelligent Tuning and Adaptive Control Symposium, Singapore, 15-17 Jan. 1991

(INPE-5274-PRE/1688) Avail: NTIS HC/MF A02

An attitude control system for a remote sensing satellite was designed by self-tuning techniques. The satellite attitude control system is modeled by a linear vector differential equation which is corrupted by random disturbances. By employing a cost function with penalized control terms, it is possible to find an implicit self-tuning controller that will adapt itself to all mission phases and will be simple enough to be implemented with microcomputers. Parameter estimation is performed by Kalman filtering techniques. The controller performance is verified by numerical simulation, using a model of a real satellite. The results show good compliance with the satellite point requirements. Author

N92-18828*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

ARTEMIS: RESULTS OF THE ENGINEERING FEASIBILITY STUDY

17 Sep. 1991 138 p

(NASA-TM-105440; NAS 1.15:105440) Avail: NTIS HC/MF A07 CSCL 22B

Information is given in viewgraph form for the Engineering Feasibility Study of the Artemis Project, a plan to establish a permanent base on the Moon. Topics covered include the Common Lunar Lander (CLL), lunar lander engineering study results, lunar lander trajectory analysis, lunar lander conceptual design and mass properties, the lunar lander communication subsystem design, and product assurance. For individual titles, see N92-18829 through N92-18841.

N92-18829*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

A COMMON LUNAR LANDER (CLL) FOR THE SPACE EXPLORATION INITIATIVE

Stephen Bailey *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 p 1-31 (For primary document see N92-18828 09-18)

Avail: NTIS HC/MF A07 CSCL 22B

Information is given in viewgraph form on the Artemis project, a plan to establish a permanent base on the Moon. Information includes a summary of past and future events, the program rationale, a summary of potential payloads, the physical characteristics of experiments, sketches of equipment, design study objectives, and details of such payloads as the Geophysical Station Network, teleoperated rovers, astronomical telescopes, a Moon-Earth radio interferometer, very low frequency radio antennas, the Lunar Polar Crater Telescope, Lunar Resource Utilization Experiments, and biological experiments. Author

N92-18830*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

COMMON LUNAR LANDER (CLL) ENGINEERING STUDY RESULTS

Jonette Stecklein *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 16 p (For primary document see N92-18828 09-18)

Avail: NTIS HC/MF A07 CSCL 22B

Information is given in viewgraph form on the Common Lunar Lander (CLL) engineering study results. The mission is to provide a delivery system to soft-land a 200 kg payload set at any given lunar latitude and longitude. Topics covered include the study schedule, mission goals and requirements, the CLL reference mission, costs, CLL options, and two stage performance analysis. Author

N92-18831*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

COMMON LUNAR LANDER (CLL) TRAJECTORY ANALYSIS **c13**

Lynn A. Wagner, Jr. and Nancy A. Wilks *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 8 p (For primary document see N92-18828 09-18)

Avail: NTIS HC/MF A07 CSCL 22A

Common Lunar Lander trajectory analysis is presented in viewgraph format. Trajectory requirements, trajectory characteristics, trajectory timeline, and alternate trajectory advantages and disadvantages are given. E.R.

N92-18832*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.

BASELINE ELVs: DELTA 2 7920 AND TITAN 2S SLV **c13**

In its Artemis: Results of the Engineering Feasibility Study 17

Sep. 1991 11 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22A

The baseline mission profiles for two expendable launch vehicles (ELVs) are presented in viewgraph format. The two expendable stage vehicles are the Delta 2 and the Titan 2S. Descriptions are given for both ELV configurations. E.R.

N92-18833*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMMON LUNAR LANDER (CLL) CONCEPTUAL DESIGN AND MASS PROPERTIES
Shelby Lawson *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 18 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

The conceptual design and mass properties are presented for the CLL in viewgraph format. The spacecraft structural mass is given for orbital assembly, thermal insulation, integrated propulsion, power generation, avionics, environment control, and pyrotechnics and landing system. The mass is given of the lander as well as the transfer stage. E.R.

N92-18834*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
STRUCTURE AND MECHANICS
George Sanger *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 5 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

Artemis is a Common Lunar Lander (CLL) design for the Space Exploration Initiative (SEI). Structure factors for the CLL's primary and secondary structures are listed in tabular form. Additionally, engineering drawings of various systems, including the propulsion and landing systems, are presented. D.R.D.

N92-18835*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMMON LUNAR LANDER (CLL) PROPULSION SYSTEM
Don Hyatt *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 4 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

A description of the Common Lunar Lander (CLL) propulsion system is given. Among the topics discussed are the following: system characteristics, system mission requirements, key drivers to subsystem selection, system readiness level, and point design output. Additionally, a schematic of the system is provided. D.R.D.

N92-18836*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
AVIONICS SUBSYSTEM
Nancy C. Smith *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 4 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

The avionics subsystem of the Common Lunar Lander (CLL) is designed to meet the following requirements: guidance, navigation, and control of the spacecraft; central computer for all subsystems; and data storage for all subsystems for telemetry purposes. A table describing the av ionics subsystem is listed. Additionally, a schematic representation of the avionics subsystem is provided. D.R.D.

N92-18837*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
TRACKING SYSTEMS TO SUPPORT THE COMMON LUNAR LANDER (CLL)
William X. Culpepper *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 7 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

A discussion of the tracking system for Artemis (the Common Lunar Lander) is presented. Among the topics presented are the following: major drivers for system definition, results of vendor survey, baseline system properties, program considerations, and mission phases requiring tracking. D.R.D.

N92-18838*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
INITIAL HARDWARE DEVELOPMENT SCHEDULE
William X. Culpepper *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 9 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

The hardware development schedule for the Common Lunar Lander's (CLLs) tracking system is presented. Among the topics covered are the following: historical perspective, solution options, industry contacts, and the rationale for selection. D.R.D.

N92-18839*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
COMMON LUNAR LANDER (CLL) COMMUNICATION SUBSYSTEM DESIGN
Henry Chen *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 14 p (For primary document see N92-18828 09-18)
(EE7-91-448) Avail: NTIS HC/MF A07 CSCL 22B

The communication subsystem is required to provide downlink for telemetry data and uplink for command data. It also provides Doppler/ranging for the state-vector generation. Detailed trades, system designs, and requirements analysis were performed to provide the most realistic estimates for the project. Author

N92-18840*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
POWER SUBSYSTEM
Betsy Kluksdahl *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 6 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

Topics concerning the Common Lunar Lander are presented in view graph form and include: energy storage and power generation; electrical power distribution and control; pyrotechniques; input from other subsystems; and design refinement following vehicle integration. Author

N92-18841*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, TX.
PRODUCT ASSURANCE TARGETED TO MEET MISSION OBJECTIVES
Diane McLaughlin *In its* Artemis: Results of the Engineering Feasibility Study 17 Sep. 1991 3 p (For primary document see N92-18828 09-18)
Avail: NTIS HC/MF A07 CSCL 22B

Topics concerning the Common Lunar Lander for the Space Exploration Initiative are covered and include the following: product assurance tools and supports; project goals; and product assurance structured for optimal payback. Author

N92-18844*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
A COMPARISON OF WHIPPLE SHIELD HYPERVELOCITY IMPACT TESTS TO PENETRATION PREDICTORS
S. A. Hill, L. C. Chhabildas, and E. S. Hertel (Sandia National Labs., Albuquerque, NM.) 1991 4 p Presented at the 42nd International Aeronautical Federation Congress (IAEFC), Montreal, Quebec, 7-11 Oct. 1991
(Contract NASA Order H-99071-B; DE-AC04-76DP-00789)
(NASA-TM-105107; NAS 1.15:105107; DE92-004740; SAND-91-2399C; CONF-9110217-6) Avail: NTIS HC/MF A01 CSCL 22B

The purpose of this paper is to develop an analytical model to convert ballistic limit curves obtained from flat projectile experiments to ballistic limit curves based on equivalent diameter

spheres. Results from a test program involving flat plate projectiles conducted at Sandia National Laboratories are compared against the predicted performance of equivalent spherical projectiles as determined from the Wilkinson and Cour-Palais penetration equations. The developed method demonstrates good correlation of the ballistic limit of the shield concept for the flat plate projectiles to the theoretical ballistic limit for equivalent spheres as predicted by the penetration equations. DOE

N92-18941# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
APPLICATION OF LOW THRUST PROPULSION TECHNIQUES TO SATELLITE ATTITUDE CONTROL SYSTEMS M.S. Thesis
Jeffrey J. Abbott Nov. 1991 108 p
(AD-A243890; AFIT/GA/ENY/91D-9) Avail: NTIS HC/MF A06
CSCL 22/3

Equations of motion for a satellite controlled through continuous, low thrust propulsion systems are analyzed through numerical integration techniques. The equations of motion are derived using the Euler 'Moment Equations. The properties of the satellite model are based upon the Intelsat VII design of communications satellite. A simple rate and error feedback controller is used in providing active attitude control about two and three axes. Perturbation models are created and applied based upon the satellite model. Parameters varied include thrust levels and controller deadband widths. System response times, pointing accuracy, and total impulse required for attitude control are determined as measurements of relative performance. GRA

19 SPACECRAFT INSTRUMENTATION

For related information see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

N92-18337# National Oceanic and Atmospheric Administration, Washington, DC. Office of Research and Applications.
EVALUATING THE DESIGN OF SATELLITE SCANNING RADIOMETERS FOR EARTH RADIATION BUDGET MEASUREMENTS WITH SYSTEM SIMULATIONS. PART 1: INSTANTANEOUS ESTIMATES
Larry Stowe, Philip Ardanuy, Richard Hucek, Peter Abel (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.), and Herbert Jacobowitz Oct. 1991 132 p
(Contract NOAA-50-DDNE-6-00217)
(NOAA-TR-NESDIS-58) Avail: NTIS HC/MF A07

A set of system simulations was performed to evaluate candidate scanner configurations to fly as a part of the Earth Radiation Budget Instrument (ERBI) on the polar platforms during the 1990's. The simulation is considered of instantaneous sampling (without diurnal averaging) of the longwave and shortwave fluxes at the top of the atmosphere (TOA). After measurement and subsequent inversion to the TOA, the measured fluxes were compared to the reference fluxes for 2.5 deg lat/long resolution targets. The reference fluxes at this resolution are obtained by integrating over the 25 x 25 = 625 grid elements in each target. The differences between each of these two resultant spatially averaged sets of target measurements (errors) are taken and then statistically summarized. Five instruments are considered: (1) the Conically Scanning Radiometer (CSR); (2) the ERBE Cross Track Scanner; (3) the Nimbus-7 Biaxial Scanner; (4) the Clouds and Earth's Radiant Energy System Instrument (CERES-1); and (5) the Active Cavity Array (ACA). Identical studies of instantaneous error were completed for many days, two seasons, and several satellite equator crossing longitudes. The longwave flux errors were found to have the same space and time characteristics as for the shortwave fluxes, but the errors are only about 25 pct. of the shortwave errors. Author

20 SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxilliary power sources.

For related information see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

N92-18152# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
COMET RIDERS: NUCLEAR NOMADS TO THE STARS
J. A. Angelo, Jr. (Science Applications International Corp., Melbourne, FL.) and D. Buden 1991 7 p Presented at the 42nd International Aeronautical Federation Congress (IAEFC), Montreal, Quebec, 7-11 Oct. 1991
(Contract DE-AC07-76ID-01570)
(DE92-003287; EGG-M-91485; CONF-9110217-5) Avail: NTIS HC/MF A02

This paper describes the potential role of an evolutionary family of advanced space nuclear power systems (solid core reactor, gas core reactor, and thermonulcear fusion systems) in the detailed exploration of Solar System comets and in the use of interstellar comets to support migratory journeys to the stars by both human beings and their smart robot systems. DOE

N92-18229# Sandia National Labs., Albuquerque, NM.
A FISSION FRAGMENT REACTOR CONCEPT FOR NUCLEAR THERMAL PROPULSION
A. J. Suo-Anttila, E. J. Parma, P. S. Pickard, S. A. Wright, and M. E. Vernon 16 Sep. 1991 12 p Presented at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 13-16 Jan. 1992
(Contract DE-AC04-76DP-00789)
(DE92-003298; SAND-91-2310C; CONF-920104-20) Avail: NTIS HC/MF A03

The Space Exploration Initiative requires the development of nuclear thermal and nuclear electric technologies for space propulsion for future Lunar and Mars missions. Sandia National Laboratories has proposed a new nuclear thermal propulsion concept that uses fission fragments to directly heat the propellant up to 1000 K or higher above the material temperatures. The concept offers significant advantages over traditional solid-core nuclear rocket concepts because of higher propellant exit temperatures, while at the same time providing for more reliable operation due to lower structure temperatures and lower power densities. The reactor can be operated in either a steady-state or pulsed mode. The steady-state mode provides a high thrust and relatively high specific impulse, as compared to other nuclear thermal concepts. The pulsed mode requires an auxillary radiator for cooling, but has the possibility of achieving very high specific impulses and thrust scaleable to the radiator size. The propellant temperatures are limited only by thermal radiation and transient heat conduction back to the substrate walls. DOE

N92-18240# National Aerospace Lab., Tokyo (Japan).
SWEPT FREQUENCY TYPE OF ULTRASONIC INSPECTION METHOD FOR LINER-PROPELLANT SEPARATIONS OF SOLID MOTORS
Morio Shimizu May 1991 58 p In JAPANESE; ENGLISH summary
(NAL-TR-1107; ISSN-0389-4010) Avail: NTIS HC/MF A04

A swept frequency type ultrasonic inspection method is used for inspecting not only case liner separations, but also liner propellant separations of solid motors, with its successful application to the H-I upper stage motors also being discussed. This new method has been in development at the National Aerospace Lab (NAL) since 1968, and is based on using the one dimensional quarter wavelength resonance principle to determine the liner thickness under both free and fixed end face boundary condition, being considered to be the liner's line propellant separation boundary condition. Since the motor cases have curved

(spherical/cylindrical) surfaces, several curved contact surface probes were developed. This method was subsequently applied to test successfully both the apogee and third stage motor of the H-I rocket during manufacturing and also at the launch site. This inspection has contributed to successful launching of the H-I rocket since the first launching in August 1987, and will be applied to the Solid Rocket Booster (SRB) of the H-II rocket. Author

N92-18280*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

A SURVEY OF INSTABILITIES WITHIN CENTRIFUGAL PUMPS AND CONCEPTS FOR IMPROVING THE FLOW RANGE OF PUMPS IN ROCKET ENGINES

Joseph P. Veres Feb. 1992 17 p Proposed for presentation at the 1992 JANNAF Propulsion Meeting, Indianapolis, IN, 24-28 1992

(NASA-TM-105439; E-6859; NAS 1.15:105439) Avail: NTIS HC/MF A03 CSCL 21H

Design features and concepts that have primary influence on the stable operating flow range of propellant-feed centrifugal turbopumps in a rocket engine are discussed. One of the throttling limitations of a pump-fed rocket engine is the stable operating range of the pump. Several varieties of pump hydraulic instabilities are mentioned. Some pump design criteria are summarized and a qualitative correlation of key parameters to pump stall and surge are referenced. Some of the design criteria were taken from the literature on high pressure ratio centrifugal compressors. Therefore, these have yet to be validated for extending the stable operating flow range of high-head pumps. Casing treatment devices, dynamic fluid-damping plenums, backflow-stabilizing vanes and flow-reinjection techniques are summarized. A planned program was undertaken at LeRC to validate these concepts. Technologies developed by this program will be available for the design of turbopumps for advanced space rocket engines for use by NASA in future space missions where throttling is essential. Author

N92-18420# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.

COST EFFECTIVE DEVELOPMENT OF A NUCLEAR THERMAL ROCKET ENGINE (NTRE)

C. F. Leyse, J. H. Ramsthaler, D. W. Culver, and V. E. Haloulakos 1991 11 p Presented at the AIAA/NASA/OAI Conference on Advanced Space Exploration Initiative (SEI) Technologies, Cleveland, OH, 3-4 Sep. 1991 Previously announced in IAA as A91-52452

(Contract DE-AC07-76ID-01570)

(DE92-003320; EGG-M-91428; CONF-9109226-25) Avail: NTIS HC/MF A03

It is proposed that the development of a small, low thrust engine is a cost effective approach to the development of an NTRE and that an early version of such an engine could be available for a flight test program by the year 2000. The development of a low thrust (e.g., 2000 to 5000 lbf) engine can utilize existing, upgraded and modified development and test facilities, thus avoiding the large up-front cost of the very large facilities required for testing high thrust (e.g., greater than or = 75,000 lbf) NTREs. Near term (Tc = 2500 K) and advanced (Tc = 32000 K) versions of a high pressure (P sub c = 500 psia) and a low pressure (P sub c = 50 psia) NTRE are described and mission performance evaluated for a typical space mission involving the potential payload to GEO assuming a Titan IV launch of 40 klbm to LEO. Potential payloads of the advanced engine are approximately 50 pct. greater than the payload of high performance LOX-hydrogen chemical engines. The low pressure engine is indicated to out-perform the high pressure concept. Clustering of eight to sixteen 5000 lbf thrust engines may be feasible and would provide sufficient thrust for human missions to Mars, thereby eliminating the costly and time consuming development of a high thrust NTRE. Considering the differences in costs of test facilities, test engines, engine ground and flight testing and deployment date, the low thrust engine could result in savings of several billions dollars compared to development of a high (e.g., 75,000 lbf) engine. DOE

N92-18465# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

PROPULSION SUBSYSTEM COMPONENT DEVELOPMENT PROGRAM FOR THE MECB RSS SATELLITE

José Nivaldo Hinckel, Evaldo Jose Corat, Vladimir Jesus Trava-Airoldi, and Claudio Bressan Jun. 1991 7 p Presented at the 27th AIAA/SAE/ASME Joint Propulsion Conference, Sacramento, CA, 24-26 Jun. 1991 Previously announced in IAA as A91-41628

(INPE-5276-PRE/1690) Avail: NTIS HC/MF A02

The development program for a satellite propulsion system at INPE (Brazil) is presented. All components for the reaction control system, including hydrazine tank, fill and drain valve, hydrazine filter, control valve and monopropellant hydrazine catalytic thruster are being built and tested. The system is designed to satisfy the propulsion requirements of a three-axis stabilized remote sensing satellite designed by INPE, to be launched in 1995. The thruster test facility and measurement techniques are described. Author

N92-18474*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.

PRELIMINARY TEST RESULTS OF A HOLLOW CATHODE MPD THRUSTER

Maris A. Mantenieks and Roger M. Myers (Sverdrup Technology, Inc., Brook Park, OH.) 1991 16 p Presented at the 22d International Electric Propulsion Conference, Viareggio, Italy, 14-17 Oct. 1991; sponsored by AIDAA, AIAA, DGLR, and JSASS

(NASA-TM-105324; E-6608; NAS 1.15:105324; IEPC-91-076) Avail: NTIS HC/MF A03 CSCL 21C

Performance of four hollow cathode configurations with low work function inserts was evaluated in a steady-state 100 kW class applied magnetic field magnetoplasmadynamic (MPD) thruster. Two of the configurations exhibited stable discharge current attachment to the low work function inserts of the hollow cathodes. A maximum discharge current of 2250 A was attained. While the applied-field increased the performance of the thruster, at high applied fields the discharge current attachment moved from the insert to the cathode body. The first successful hollow cathode performed well in comparison with a conventional rod cathode MPD thruster, attaining a thrust efficiency with argon of close to 20 percent at a specific impulse of about 2000 s. The second successful configuration had significantly lower performance. Author

N92-18498# Sandia National Labs., Albuquerque, NM.

NUCLEAR THERMAL PROPULSION TEST FACILITY REQUIREMENTS AND DEVELOPMENT STRATEGY

George C. Allen, John Warren, and J. S. Clark (National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.) 18 Oct. 1991 12 p Presented at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 13-16 Jan. 1992

(Contract DE-AC04-76DP-00789)

(DE92-002923; SAND-91-2315C; CONF-920104-18) Avail: NTIS HC/MF A03

The Nuclear Thermal Propulsion (NTP) subpanel of the Space Nuclear Propulsion Test Facilities Panel evaluated facility requirements and strategies for nuclear thermal propulsion systems development. High pressure, solid core concepts were considered as the baseline for the evaluation, with low pressure concepts an alternative. The work of the NTP subpanel revealed that a wealth of facilities already exists to support NTP development, and that only a few new facilities must be constructed. Some modifications to existing facilities will be required. Present funding emphasis should be on long-lead-time items for the major new ground test facility complex and on facilities supporting nuclear fuel development, hot hydrogen flow test facilities, and low power critical facilities. DOE

N92-18549# Lawrence Livermore National Lab., CA.

MINIATURIZED PRESSURIZATION SYSTEM Patent Application

J. C. Whitehead, inventor (to DOE) and D. G. Swink, inventor (to DOE) 9 Jul. 1990 22 p

(Contract W-7405-eng-48)
(DE92-003821; US-Patent-Appl-SN-550280;
Patents-US-A7550280) Avail: NTIS HC/MF A03

This invention uses a fluid stored at a low pressure and provides the fluid at a high pressure. The invention allows the low pressure fluid to flow to a fluid bore of a differential pump and from the pump to a fluid pressure regulator. After flowing through the regulator, the fluid is converted to a gas which is directed to a gas bore of the differential pump. By controlling the flow of gas entering and being exhausted from the gas bore, the invention provides pressure to the fluid. By setting the regulator, the high pressure fluid can be set at predetermined values. Because the invention only needs a low pressure fluid, the inventive apparatus has a low mass and, therefore, would be useful in rocket propulsion systems. Author

N92-18906# Air Force Inst. of Tech., Wright-Patterson AFB, OH. Foreign Technology Div.
POGO STABILITY, RELIABILITY, AND PARAMETERS ANALYSIS
Qiz-Heng' Wang, Wan-Yong Gau, Yong-Chun Gu, Jitony Zhang, and Xian-Shan Li 19 Nov. 1991 53 p Transl. into ENGLISH from Xuebao (Yuhang, China), no. 2, 1986 p 29-47
(AD-A244379; FTD-ID(RS)T-0572-91) Avail: NTIS HC/MF A04 CSCL 16/2

POGO instability is one of the most important dynamical problems of space vehicles. The mechanism of the POGO instability is briefly clarified by a simple free-free system which consists of two masses, a spring, and a damper, followed by POGO stability matrix algorithm, POGO stability single transfer method, and POGO stability analysis estimation method. The adaptability of these POGO stability analysis is illustrated through an example. After important parameters related to POGO instability are discussed, the reliability analysis of POGO stability and its criteria are also introduced. POGO is the study of structural instability of the rocket body structural system and the longitudinal coupling of the propulsion system. Under the condition of POGO, longitudinal self-stimulating non-convergent vibration of the space vehicle is caused which is similar to the ever-jumping pogo stick and hence was given the name. GRA

N92-18926*# California Univ., Santa Barbara. Dept. of Mechanical and Environmental Engineering.
LONG TERM INTEGRITY FOR SPACE STATION POWER SYSTEMS
F. A. Leckie and D. L. Marriott (Illinois Univ., Urbana-Champaign.) Jan. 1991 69 p
(Grant NAG3-1218)
(NASA-CR-189910; NAS 1.26:189910) Avail: NTIS HC/MF A04 CSCL 10B

A study was made of the High Temperature Design Codes ASME N47, British R5, and the French RCC-MR Rules. It is concluded that all these codes provide a good basis of design for space application. The new British R5 is the most complete since it deals with the problem of defects. The ASME N47 was subjected longer to practical application and scrutiny. A draft code is introduced, and a proposed draft for high temperature design in which attempts were made to identify gaps and improvements is suggested. The design is limited by creep characteristics. In these circumstances, life is strongly affected by the selected value of the factor of safety. The factor of safety of primary loads adopted in the codes is 1.5. Maybe a lower value of 1.25 is permissible for use in space. Long term creep rupture data for HAYNES 188 is deficient and it is suggested that extrapolation methods be investigated. Author

N92-18942# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
THRUST VECTOR CONTROL OF AN OVEREXPANDED SUPERSONIC NOZZLE USING PIN INSERTION AND ROTATING AIRFOILS M.S. Thesis
Curtis R. Amble Dec. 1991 102 p
(AD-A243891) Avail: NTIS HC/MF A06 CSCL 21/8

An experimental study of probe thrust vector control of overexpanded supersonic flow in nozzles using movable probes as the vectoring mechanism is presented. Two types of movable probes were used. The first inserted cylindrical probes through the wall of the nozzle to set depths relative to the nozzle wall; the second used rotating airfoils, inserted within the nozzle flow, rotated to various angles of attack relative to the nozzle centerline. Effectiveness of these probe thrust vector control mechanisms was investigated for a confined jet and conical nozzle. The study objective was to evaluate performance and transient characteristics of these probe thrust vector control mechanisms. Data are presented for both a confined jet nozzle and conical nozzle operating with primary stagnation pressures ranging from 150 psia to 460 psia and exhausting to atmospheric pressure. The range in pressure above 150 psia represents the region where flow in both configurations is stable and supersonic in axial operation. Limitations in the pressure supply allowed evaluation of both configurations only in the overexpanded flow regime. Axial force, lateral force, and static nozzle wall pressure distribution data were measured for axial and vectored operation for each nozzle configuration. Test results showed that probe thrust vector control using cylindrical pin insertion is a viable thrust vectoring mechanism. Performance of the cylindrical pins was repeatable in both nozzle configurations. GRA

N92-18948*# Hughes Research Labs., Malibu, CA.
HIGH POWER ION THRUSTER TECHNOLOGY Final Report, 20 Oct. 1988 - 19 Oct. 1989
J. R. Beattie and J. N. Matossian 21 Feb. 1992 97 p
(Contract NAS3-25553)
(NASA-CR-187161; NAS 1.26:187161) Avail: NTIS HC/MF A05 CSCL 21C

Steady state performance data using xenon propellant are presented for a 25 cm diam thruster operated over the power range from 1.8 to 6.8 kW, and for a 30 cm diam thruster operated over the power range from 1.4 to 11.1 kW. The SmCo5 permanent magnets used to produce the ring cusp magnetic confinement geometry in these devices have a temperature limit of approx. 320 C. This thermal limit restricts the power handling capacity of the 25 cm diam discharge chamber to P sub D approx. 490 W. At this maximum input power, the beam current is limited to about J sub b = 4 A for operation at a beam ion production cost of sigma sub i = 120 W/A. Under these conditions, and with a discharge voltage of V sub D = 28 V, the 25 cm diam thruster can convert 6.8 kW of input power into thrust beam power with a thruster efficiency of Eta sub t = 76 pct., a specific impulse of I sub sp = 4338 s, and a thrust of F = 245 mN. The increased beam area (approx. 30 pct.) of the 30 cm diam thruster allows it to accommodate as high as 790 W of discharge power without exceeding the temperature limitation on its SmCo5 magnets. With a discharge power of P sub D = 785 W, operation at a beam ion production cost of sigma sub i = 140 W/A limits the upper value of beam current to approx. J = 5.6 A. At this operating point, and with a discharge voltage of V sub D = 28 V, the 30 cm diam thruster can convert 11.1 kW of input power into thrust beam power with a thruster efficiency of Eta sub t = 83 pct., a specific impulse of I sub sp approx. = 5160 s, and a thrust of F = 364 mN. Author

N92-18636# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
INTEGRATION OF RAMS ACTIVITIES DURING THE DEVELOPMENT PHASE OF ARIANE-5 COMPONENTS (EXAMPLE: VULCAIN THRUST CHAMBER)
Claudia Lex *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 175-178 (For primary document see N92-18607 09-31)
(MBB-UK-0144-PUB; OTN-033152) Copyright Avail: NTIS HC/MF A13

23 CHEMISTRY AND MATERIALS (GENERAL)

N92-18457*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CHEMICAL VAPOR DEPOSITION MODELING FOR HIGH TEMPERATURE MATERIALS
Sueleyman Goekoglu 1992 14 p Presented at the 1991 Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(NASA-TM-105386; E-6772; NAS 1.15:105386) Avail: NTIS HC/MF A03 CSCL 07A

The formalism for the accurate modeling of chemical vapor deposition (CVD) processes has matured based on the well established principles of transport phenomena and chemical kinetics in the gas phase and on surfaces. The utility and limitations of such models are discussed in practical applications for high temperature structural materials. Attention is drawn to the complexities and uncertainties in chemical kinetics. Traditional approaches based on only equilibrium thermochemistry and/or transport phenomena are defended as useful tools, within their validity, for engineering purposes. The role of modeling is discussed within the context of establishing the link between CVD process parameters and material microstructures/properties. It is argued that CVD modeling is an essential part of designing CVD equipment and controlling/optimizing CVD processes for the production and/or coating of high performance structural materials. Author

N92-18711# Illinois Univ., Urbana. Materials Research Lab.
[MATERIALS RESEARCH LABORATORY OVERVIEW]
Progress Report, FY-91
Oct. 1991 130 p
(Contract DE-FG02-91ER-45439)
(DE92-004051; DOE/ER-45439/1) Avail: NTIS HC/MF A07

The Materials Research Laboratory at the University of Illinois is an interdisciplinary laboratory operated in the College of Engineering. Its focus is the science of materials and it supports research in the areas of condensed matter physics, solid state chemistry, and materials science. This report addresses topics such as: an MRL overview; budget; general programmatic and institutional issues; new programs; research summaries for metallurgy, ceramics, solid state physics, and materials chemistry. DOE

N92-18855# Nevada Univ., Reno.
HIGH TEMPERATURE CHEMISTRY OF AROMATIC HYDROCARBONS
L. T. Scott 1991 8 p
(Contract DE-FG08-88ER-13945)
(DE92-005305; DOE/ER-13945/3) Avail: NTIS HC/MF A02

We have not only gained new insight into the mechanism and generality of Polycyclic Aromatic Hydrocarbon (PAH) thermal automerization reactions, we have also uncovered several new high temperature reactions and added a third dimension to our program by applying high temperature chemistry to problems in organic synthesis. Our synthesis of corannulene has attracted much recent attention; however, we believe that the uncatalyzed 'cyclodehydrogenation reactions' which form 5-membered rings and 6-membered rings at high temperatures may prove to be of greater general importance in the long term. This bias is reflected in the accompanying proposal. DOE

N92-18970*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FLUORESCENCE MICROSCOPY FOR THE CHARACTERIZATION OF STRUCTURAL INTEGRITY
Kenneth W. Street and Todd A. Leonhardt (Sverdrup Technology, Inc., Brook Park, OH.) 1991 14 p Presented at the 24th Annual International Metallographic Society Technical Meeting, Monterey, CA, 29 Jul. - 1 Aug. 1991 Original contains color illustrations
(Contract NAS3-25266)
(NASA-TM-105253; E-6582; NAS 1.15:105253) Avail: NTIS HC/MF A03; 3 functional color pages CSCL 07A

The absorption characteristics of light and the optical technique of fluorescence microscopy for enhancing metallographic interpretation are presented. Characterization of thermally sprayed coatings by optical microscopy suffers because of the tendency for misidentification of the microstructure produced by metallographic preparation. Gray scale, in bright field microscopy, is frequently the only means of differentiating the actual structural details of porosity, cracking, and debonding of coatings. Fluorescence microscopy is a technique that helps to distinguish the artifacts of metallographic preparation (pullout, cracking, debonding) from the microstructure of the specimen by color contrasting structural differences. Alternative instrumentation and the use of other dye systems are also discussed. The combination of epoxy vacuum infiltration with fluorescence microscopy to verify microstructural defects is an effective means to characterize advanced materials and to assess structural integrity. Author

24 COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

For ceramic materials see *27 Nonmetallic Materials*.

N92-18315# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Military Aircraft Div.
COMPOSITE COMPRESSION TESTING METHODS AND ANALYTICAL VERIFICATION
Josef W. Vilsmeier, Juergen Brandt, and Klaus Drechsler 1991 11 p Presented at the 12th International SAMPE European Conference, Maastricht, Netherlands, 28-30 May 1991
(MBB-Z-0358-91-PUB; ETN-92-90609) Avail: NTIS HC/MF A03

An overview of test methods to determine unidirectional carbon fiber composite compression strength, the most difficult property of fiber reinforced plastics to test, is presented. In the design process the compression strength is an important limiting parameter for minimum weight structures. Test methods used on the Celanese type specimen and test rig are presented and actual solutions for the unidirectional compression specimen and the test rigs for unidirectional compression and multidirectional compression after impact tests are shown. ESA

N92-18329# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Labs.
COMPOSITES WITH KNITTED FIBRE REINFORCEMENT
F. J. Arendts (Stuttgart Univ., Germany, F.R.) and Klaus Drechsler 1990 9 p Presented at the 3rd International Symposium on Advanced Composites in Emerging Technologies, Patras, Greece, 20-24 Aug. 1990
(MBB-Z-0356-90-PUB; ETN-92-90607) Avail: NTIS HC/MF A02

The potential uses of composites with knitted fiber reinforcements are studied. Their superior energy absorption behavior opens up interesting application fields when stiffness and strength are of less importance. The in-plane properties can be varied over a wide range through the choice of fiber structure. Stretching the mesh system before consolidation yields the same stiffness and strength as that of woven structures. The high drapability of the mesh structure allows for cost effective lamination of spherical curved parts. ESA

N92-18330# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Control Labs.
APPROACHES FOR IMPROVING THE DAMAGE TOLERANCE OF COMPOSITE STRUCTURES
J. Brandt, Klaus Drechsler, and F. J. Arendts (Stuttgart Univ., Germany, F.R.) 1990 8 p Presented at the 4th European Conference on Composite Materials, Stuttgart, Fed. Republic of Germany, 25-28 Sep. 1990
(MBB-Z-0357-90-PUB; ETN-92-90608) Avail: NTIS HC/MF A02

The damage tolerance of carbon fiber reinforced composites

is studied. These composites tend to have considerably lower tolerances than those of many metals or composites containing glass or organic fibers. As a result, they are susceptible to impact damage which may lead to delamination. Various solutions are proposed to overcome these limitations. Three dimensional reinforcement, composite design, matrix toughness and interleafing are some of the concepts discussed in view of improving the damage tolerance characteristics. ESA

N92-18439*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
CVD OF SILICON CARBIDE ON STRUCTURAL FIBERS: MICROSTRUCTURE AND COMPOSITION
Lisa C. Veitch, Francis M. Terepka, and Suleyman A. Gokoglu 1992 7 p Presented at the 1991 Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(NASA-TM-105385; E-6770; NAS 1.15:105385) Avail: NTIS HC/MF A02 CSCL 11D

Structural fibers are currently being considered as reinforcements for intermetallic and ceramic materials. Some of these fibers, however, are easily degraded in a high temperature oxidative environment. Therefore, coatings are needed to protect the fibers from environmental attack. Silicon carbide (SiC) was chemically vapor deposited (CVD) on Textron's SCS6 fibers. Fiber temperatures ranging from 1350 to 1500 C were studied. Silane (SiH4) and propane (C2H8) were used for the source gases and different concentrations of these source gases were studied. Deposition rates were determined for each group of fibers at different temperatures. Less variation in deposition rates were observed for the dilute source gas experiments than the concentrated source gas experiments. A careful analysis was performed on the stoichiometry of the CVD SiC coating using electron microprobe. Microstructures for the different conditions were compared. At 1350 C, the microstructures were similar; however, at higher temperatures, the microstructure for the more concentrated source gas group were porous and columnar in comparison to the cross sections taken from the same area for the dilute source gas group. Author

N92-18561* National Aeronautics and Space Administration. Pasadena Office, CA.
FABRICATION OF NANOMETER SINGLE CRYSTAL METALLIC CoSi2 STRUCTURES ON Si Patent
Kai-Wei Nieh, inventor (to NASA), True-Lon Lin, inventor (to NASA), and Robert W. Fathauer, inventor (to NASA) (Jet Propulsion Lab., California Inst. of Tech., Pasadena.) 24 Dec. 1991 6 p Filed 27 Mar. 1991 Continuation of abandoned US-Patent-Appl-SN-392166, filed 10 Aug. 1989
(NASA-Case-NPO-17736-2-CU; US-Patent-5,075,243; US-Patent-Appl-SN-677373; US-Patent-Appl-SN-392166; US-Patent-Class-437-40; US-Patent-Class-437-973; US-Patent-Class-437-935; US-Patent-Class-437-942; US-Patent-Class-437-907; US-Patent-Class-437-200) Avail: US Patent and Trademark Office CSCL 11D

Amorphous Co:Si (1:2 ratio) films are electron gun-evaporated on clean Si(111), such as in a molecular beam epitaxy system. These layers are then crystallized selectively with a focused electron beam to form very small crystalline Co/Si2 regions in an amorphous matrix. Finally, the amorphous regions are etched away selectively using plasma or chemical techniques.
Official Gazette of the U.S. Patent and Trademark Office

N92-18764# National Inst. of Standards and Technology, Gaithersburg, MD.
CONE CALORIMETER RATE OF HEAT RELEASE MEASUREMENTS FOR UPHOLSTERED COMPOSITES OF POLYURETHANE FOAMS
K. M. Villa and V. Babrauskas Aug. 1991 40 p
(PB92-108984; NISTIR-4652) Avail: NTIS HC/MF A03 CSCL 11D

Certain regulatory authorities have recently banned or restricted the use of furniture upholstered with a combination of polyvinyl chloride (PVC) covering and a melamine-treated polyurethane foam padding. Thus, it was endeavored to determine if quantitative measurements would reveal any special hazards associated with this particular combination. The work represents the testing of nine different upholstered composites made of fabric coverings and polyurethane foam, tested at three different irradiance levels in the National Institute of Standards and Technology Cone Calorimeter. Additional combinations using a polyester batting interbarrier were also used. The composite bench-scale specimens were tested at 25, 35, and 50 kW/sq m irradiance levels. For most variables describing fire hazard, the performance of the combination of melamine-treated polyurethane foam and PVC fabric covering was not found to behave in an unusual manner. Only by considering the time period of 15 seconds after ignition was this combination numerically worse than all other combinations tested. GRA

N92-18848# Oak Ridge National Lab., TN.
THE EFFECT OF NEUTRON IRRADIATION ON THE STRUCTURE AND PROPERTIES OF CARBON-CARBON COMPOSITE MATERIALS
T. D. Burchell, W. P. Eatherly, J. M. Robbins, and J. P. Strizak 1991 18 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005121; CONF-911111-18) Avail: NTIS HC/MF A03

Carbon-based materials are an attractive choice for fusion reactor plasma facing components (PFCs) because of their low atomic number, superior thermal shock resistance, and low neutron activation. Next generation plasma fusion reactors, such as the International Thermonuclear Experimental Reactor (ITER), will require advanced carbon-carbon composite materials possessing extremely high thermal conductivity to manage the anticipated severe heat loads. Moreover, ignition machines such as ITER will produce high neutron fluxes. Consequently, the influence of neutron damage on the structure and properties of carbon-carbon composite materials must be evaluated. Data from an irradiation experiment are reported and discussed here. Fusion relevant graphite and carbon-carbon composites were irradiated in a target capsule in the High Flux Isotope Reactor (HFIR) at Oak Ridge National Laboratory (ORNL). A peak damage dose of 1.59 dpa at 600 C was attained. The carbon materials irradiated included nuclear graphite grade H-451 and 1-D, 2-D, 3-D carbon-carbon composite materials. Dimensional changes, thermal conductivity and strength are reported for the materials examined. The influence of fiber type, architecture, and heat treatment temperature on properties and irradiation behavior are reported. Carbon-Carbon composite dimensional changes are interpreted in terms of simple microstructural models. DOE

N92-18947*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
AN EVALUATION OF MIXED-MODE DELAMINATION FAILURE CRITERIA
J. R. Reeder Feb. 1992 52 p
(NASA-TM-104210; NAS 1.15:104210) Avail: NTIS HC/MF A04 CSCL 11D

Many different failure criteria have been suggested for mixed mode delamination toughness, but few sets of mixed mode data exist that are consistent over the full mode I opening to mode II shear load range. The mixed mode bending (MMB) test was used to measure the delamination toughness of a brittle epoxy composite, a state of the art toughened epoxy composite, and a tough thermoplastic composite over the full mixed mode range. To gain insight into the different failure responses of the different materials, the delamination fracture surfaces were also examined. An evaluation of several failure criteria which have been reported in the literature was performed, and the range of responses modeled by each criterion was analyzed. A new bilinear failure criterion was analyzed. A new bilinear failure criterion was developed based on a change in the failure mechanism observed from the delamination surfaces. The different criteria were compared to the failure criterion. The failure response of the tough thermoplastic composite could be modeled well with the bilinear

criterion but could also be modeled with the more simple linear failure criterion. Since the materials differed in their mixed mode failure response, mixed mode delamination testing will be needed to characterize a composite material. A critical evaluation is provided of the mixed mode failure criteria and should provide general guidance for selecting an appropriate criterion for other materials. Author

N92-18957*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FATIGUE DAMAGE IN CROSS-PLY TITANIUM METAL MATRIX COMPOSITES CONTAINING CENTER HOLES
J. G. Bakuckas, Jr., W. S. Johnson, and C. A. Bigelow Jan. 1992 31 p
(NASA-TM-104197; NAS 1.15:104197) Avail: NTIS HC/MF A03 CSCL 11D

The development of fatigue damage in (0/90) sub SCS-6/TI-15-3 laminates containing center holes was studied. Stress levels required for crack initiation in the matrix were predicted using an effective strain parameter and compared to experimental results. Damage progression was monitored at various stages of fatigue loading. In general, a saturated state of damage consisting of matrix cracks and fiber matrix debonding was obtained which reduced the composite modulus. Matrix cracks were bridged by the 0 deg fibers. The fatigue limit (stress causing catastrophic fracture of the laminates) was also determined. The static and post fatigue residual strengths were accurately predicted using a three dimensional elastic-plastic finite element analysis. The matrix damage that occurred during fatigue loading significantly reduced the notched strength. Author

N92-18577# Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.).
FATIGUE LIFE BEHAVIOUR OF COMPOSITE STRUCTURES
W. Broecker and K. Woithe *In* AGARD, Fatigue Management Dec. 1991 10 p (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

25 INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry.

For related information see also *77 Thermodynamics and Statistical Physics.*.

N92-18006# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
TURBULENT FREE SHEAR LAYER MIXING AND COMBUSTION
Paul E. Dimotakis 29 Jul. 1991 71 p
(Grant AF-AFOSR-0304-90; AF Proj. 2308)
(AD-A243410; GALCIT-FM91-2; AFOSR-91-0893TR) Avail: NTIS HC/MF A04 CSCL 20/4

Some experimental data on turbulent free-shear-layer growth, mixing, and chemical reactions are reviewed. The dependence of these phenomena on such fluid and flow parameters as Reynolds number, Schmidt number, and Mach number is discussed, with the aid of some direct consequences deducible from the large-scale organization of the flow as well as from some recent models. The mixing of two or more fluids that are entrained into a turbulent region is an important process from both a scientific and an applications vantage point. Species can be transported by turbulence to produce a more uniform distribution than some initial mean profile. This process is sometimes also referred to as mixing, without regard to whether the transported species are mixed on a molecular scale or not. If the issue of mixing arises in the context of chemical reactions and combustion, however, we recognize that only fluid mixed on a molecular scale can contribute to chemical product formation and associated heat release. The discussion in this paper will be limited to molecular mixing. GRA

N92-18017# International Centre for Theoretical Physics, Trieste (Italy).
TRACER DIFFUSION IN A SIMPLE LIQUID
K. Tankeshwar and F. Ould-Kaddour Jun. 1991 18 p
(DE92-609181; IC-91/136) Avail: NTIS HC/MF A03

A simple model is used to calculate the tracer diffusion in a Lennard-Jones tracer-solvent system. The influence of the size ratio between tracer and solvent, and of their mass ratio on the tracer diffusivity is investigated. The adopted model, proposed by Tankeshwar et al., is based on the idea, put forward by Zwanzing, of separating the configurational space of fluid system into a vibrational part and a structural part. The results offer an interpretation of the molecular dynamics data showing a positive deviation from Stokes-Einstein behavior for the small size of the tracer. The deviation is explicitly related to the length parameter of tracer-solvent interaction. The calculated values of the tracer diffusion coefficients for a large range of its size and mass values are quite satisfactory as judged by comparison with simulation results. DOE

N92-18061# Bettis Atomic Power Lab., West Mifflin, PA.
CONVERGENT X RAY MONOCHROMATOR FOR MOLECULAR MICROPROBE ANALYSIS Patent Application
O. O. M. Gamba, inventor (to DOE) 24 May 1990 19 p
(Contract DE-AC11-89PN-38014)
(DE92-004619; US-Patent-Appl-SN-529403;
Patents-US-A7529403) Avail: NTIS HC/MF A03

An improved apparatus and method are provided for electron spectroscopy for chemical analysis which permits analysis of micron sized regions of a heterogeneous sample surface. The apparatus includes a source of multidirectional X-ray radiation. A hollow cylindrical body receives the multidirectional X-ray radiation. The hollow cylindrical body includes a plurality of beam directing Johannsen-type diffracting crystals elements arrayed symmetrically and circumferentially around an axis of symmetry extending from the source of X-ray radiation to a surface of the sample. The array of Johannsen-type diffracting crystals transforms the multidirectional X-ray radiation into a hollow cone of monochromatic X-ray radiation that converges on a micron sized region on the sample surface. A screen opaque to X-rays is located along the axis of symmetry between the source of X-ray radiation and the sample. The screen prevents X-rays from the source from reaching the sample without being directed and diffracted by the beam directing and diffracting elements. An electron detector located along the axis of symmetry detects electrons emitted from the micron sized region of the sample surface. The electron detector is located between the X-ray screen and the sample surface. DOE

N92-18081# Paris VI Univ. (France).
INTERNATIONAL WORKSHOP ON: HYDROGEN MIGRATION AND THE STABILITY OF HYDROGEN RELATED COMPLEXES IN CRYSTALLINE SEMICONDUCTORS
6 Nov. 1991 55 p Workshop held in Fed. Republic of Germany, 3-6 Nov. 1991
(AD-A243427; R/D-6603-EE-03) Avail: NTIS HC/MF A04 CSCL 07/4

Thirty-two papers were presented at a conference. The central theme of the conference was hydrogen and its relationship with crystalline semiconductors. Among the specific areas discussed were the following: hydrogen carbon complexes in gallium arsenide; hydrogen carbon complexes in silicon; and hydrogen carbon complexes in indium phosphide. GRA

N92-18095# Texas Univ., Austin.
THE RAILPLUG: DEVELOPMENT OF A NEW IGNITOR FOR INTERNAL COMBUSTION ENGINES
R. D. Matthew, S. P. Nichols, and W. F. Weldon Oct. 1991 17 p Presented at the Initial Studies of a New Type of Ignitor: The Railplug, Toronto, Ontario, 7-10 Oct. 1991

(Contract DE-FG05-91ER-12115)
(DE92-002578; DOE/ER-12115/1; CONF-9110283-1) Avail: NTIS HC/MF A03

The goal of the railplug project is to commercialize this miniaturized railgun as an engine technology as rapidly as possible. To improve the technology transfer process, a board of industrial advisors was established. A list of representatives is included at the end of this annual report. The Railplug External Advisory Board (REAB) met in Austin on March 17 to 18, 1991 to discuss the project plan. A list of comments from the REAB is included at the end of this progress report, along with our written response to those comments. An alternate 'first' meeting with some representatives of the REAB was held on July 9, 1991. This meeting was attended by most of the board members who were unable to attend the first meeting. The second meeting of the REAB was held in Toronto, Canada, on October 10, 1991. A list of the board members comments from this meeting is included at the end of this report, along with our written response to those comments. These meetings have proven to be most useful in assuring that this project is conducted as efficiently as possible. The railplug project is essentially divided into three main tasks: (1) Railplug system development; (2) application of railplugs to engines; and (3) railplug durability. The status of each of these tasks is described below. DOE

N92-18226# Brown Univ., Providence, RI. Div. of Engineering.
NO-CHAR REACTIONS: KINETICS AND TRANSPORT ASPECTS
E. M. Suuberg, J. M. Calo, Hsisheng Teng, and W. D. Lilly Jul. 1991 215 p
(Contract DE-FG22-87PC-79929)
(DE91-018978; DOE/PC-79929/13) Avail: NTIS HC/MF A10

The reaction chemistry of NO with carbons is quite complex. This study details many different aspects of this chemistry. The choice was made to study the reaction chemistry using carbons derived from phenolic resins. These chars are microporous and have porosity characteristics similar to those of coal chars, but have the advantage that they are relatively free of potentially catalytic impurities. The results have been noted to be quite similar to results obtained on a variety of very different carbons, as reported in the literature. The reaction behavior was studied over a range of NO pressures up to 10.1 kPa, and at temperatures between 323 K and 1073 K. The reaction behavior is an extremely sensitive function of temperature. DOE

N92-18253# Aerospatiale Aquitaine, Saint-Medard en Jalles (France).
CHARACTERIZATION OF C-B-N SOLID SOLUTIONS DEPOSITED FROM A GASEOUS PHASE BETWEEN 900 AND 1050C
Frederic Saugnac, Francis Teyssandier, and Andre Marchand (Centre de Recherche Paul Pascal, Pessac, France) 1991 39 p
(Rept-911-430-132; ETN-92-90263) Avail: NTIS HC/MF A03

The composition, the structure and some physical properties of boron-carbon-nitrogen solid solutions prepared by Chemical Vapor Deposition (CVD) were investigated. Both crystalline films and amorphous granular materials resulting respectively from heterogeneous and homogeneous nucleation were characterized by X-ray diffraction, X-ray Photoelectron Spectroscopy (XPS), and Rutherford Backscattering Spectrometry (RBS) and Transmision Electron Microscopy (TEM). The composition of these single phase materials are gathered in two domains located in the (B/N) is greater than 1 part of the C-B-N composition diagram. It is stated that the carbon rich domain results from structural disorder of an ideal C5B2N composition. The thermal behavior of these films indicates that no mass loss can be detected after 1 hour at 1700C but a graphitization and a formation of small amounts of B13C2 are observed. Density and preliminary electrical conductivity measurements were also performed. ESA

N92-18381# International Centre for Theoretical Physics, Trieste (Italy).
SINGLE PHOTON DOUBLE IONIZATION OF HELIUM
S. N. Tiwary May 1991 15 p
(DE92-609186; LAMP-91/3) Avail: NTIS HC/MF A03

We have calculated the single photon double ionization cross section of helium using the fully correlated wave function for the ground state and partially correlated wave function for the final state. Our present theoretical investigation demonstrates that the inclusion of the full correlation in the initial as well as the final state wave function is indispensable in order to obtain reliable results in the close vicinity of the threshold. DOE

N92-18444# Kansas State Univ., Manhattan. Dept. of Chemistry.
EXCITED STATE KINETICS OF MERCURY AND CADMIUM HALIDES AND NITROGEN FLUORIDE Final Report, 15 Mar. 1984 - 14 Apr. 1985
D. W. Setser Sep. 1991 32 p
(Contract F29601-84-K-0030)
(AD-A243085; PL-TN-91-1062) Avail: NTIS HC/MF A03
CSCL 07/4

Twelve progress reports on the investigation of the excited state kinetics of mercury and cadmium halides and nitrogen fluoride conducted by the Department of Chemistry, Kansas State University, between 15 Mar. 1984 and 1 Apr. 1985 are presented. GRA

N92-18472# International Centre for Theoretical Physics, Trieste (Italy).
IONIC EFFECT IN THE THEORY OF CHEMISORPTION
E. G. Goryachev and D. V. Kuznetsov Jul. 1991 12 p
(DE92-603737; IC-91/165) Avail: NTIS HC/MF A03

The Brenig and Schonhammer solution for chemisorption has been improved due to ionic shift (delta). The spectral density (SD) of an adatom is found in the weak and intermediate coupling case (V less than or equal to W). The significant role of ionic shift is discussed for an explanation of observable asymmetrical peaks. DOE

N92-18488# International Centre for Theoretical Physics, Trieste (Italy).
THE CONVECTION PATTERNS IN MICROEMULSIONS
W. Korneta, M. A. LopezQuintela, and A. FernandezNovoa (Santiago Univ., Compostela, Spain) Jul. 1991 9 p
(DE92-609238; IC-91/156) Avail: NTIS HC/MF A02

The Rayleigh-Benard convection in the microemulsion consisting of water (7.5 percent), cyclohexan (oil - 61.7 percent), and diethylenglycol monobutylether (surfactant - 30.8 percent) is studied from the onset of convection to the phase separation. The five classes of convection patterns are observed and recorded on the video: localized travelling waves, travelling waves, travelling waves and localized steady rolls, steady rolls, and steady polygons. The Fourier transforms and histograms of these patterns are presented. The origin of any pattern is discussed. The intermittent behavior close to the phase separation was observed. Possible applications of the obtained results are suggested. DOE

N92-18496# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
SOLIDIFICATION OF SALT SOLUTIONS ON A HORIZONTAL SURFACE
S. L. Braga and R. Viskanta (Purdue Univ., West Lafayette, IN.) 1990 5 p Presented at the 3rd National Meeting of Thermal Sciences, Itapema (Brazil), 10-12 Dec. 1990
(DE92-604586; INIS-BR-2817; CONF-9012116) Avail: NTIS HC/MF A01

The freezing of water-salt solutions on a horizontal wall is investigated experimentally and theoretically. The growth of the solid-liquid region is observed for NaCl - H2O and NH4Cl - H2O systems under different temperature and concentration conditions. A unidirectional mathematical model is used to predict the solidification process. The transport of heat is by diffusion, and

convection is absent. The mass diffusion is neglected and the growth of crystal is governed by the transport of heat. In all experiments, the solution salt concentration is smaller than the eutectic composition, and the wall temperature is higher than the eutectic temperature. The predicted temperature and salt concentration profiles, as well as the interface position, are compared with experimental data. DOE

N92-18508# Oak Ridge National Lab., TN.
A METHOD AND APPARATUS FOR CONTINUOUS ELECTROPHORESIS Patent Application
J. S. Watson, inventor (to DOE) 1990 22 p
(Contract DE-AC05-84OR-21400)
(DE92-003822; US-Patent-Appl-SN-551387; Patents-US-A7551387) Avail: NTIS HC/MF A03

A method and apparatus for conducting continuous separation of substances by electrophoresis are disclosed. The process involves electrophoretic separation combined with couette flow in a thin volume defined by opposing surfaces. By alternating the polarity of the applied potential and producing reciprocating short rotations of at least one of the surfaces relative to the other, small increments of separation accumulate to cause substantial, useful segregation of electrophoretically separable components in a continuous flow system. DOE

N92-18545# Allied-Signal Aerospace Co., Kansas City, MO.
DEVELOPMENT OF HIGH PERFORMANCE LIQUID CHROMATOGRAPHIC METHODS FOR COPPER CYANIDE PLATING BATH ADDITIVES
R. L. Foster Dec. 1991 60 p
(Contract DE-AC04-76DP-00613)
(DE92-004879; KCP-613-4506) Avail: NTIS HC/MF A04

The analysis of two plating bath additives used in a copper cyanide plating process are described. Methods were developed that produced HPLC separation of the components and identification of the separated components obtained through mass spectral and nuclear magnetic resonance analyses. The methods can be used for acceptance testing of the additives, and quantitation of components can be performed if suitable standards are obtained. Napthalene sulfonic acid detergents, diphenylsulfones, and five different unidentified compounds behaving like salts were found in additive A. Additive B was found to contain the compound 2-pentene-3-ol, and two or three more components may be present. Acidification with phosphoric acid to a pH of about 2.5 produced a distinctly different chromatogram, indicating the components are affected by pH. DOE

N92-18548# General Electric Co., Schenectady, NY.
ELECTROCHEMICAL POLISHING OF THREAD FASTENER TEST SPECIMENS OF NICKEL-CHROMIUM IRON ALLOYS Patent Application
A. R. Kephart, inventor (to DOE) 3 Jul. 1990 17 p
(Contract DE-AC12-76SN-00052)
(DE92-003818; US-Patent-Appl-SN-547370; Patents-US-A7547370) Avail: NTIS HC/MF A03

An electrochemical polishing device and method for selective anodic dissolution of the surface of the test specimens comprised, for example, of nickel-chromium-iron alloys are presented. This provides for uniform dissolution at the localized sites to remove metal through the use of a coiled wire electrode (cathode) placed in the immediate proximity of the working surface, resulting in a polished and uniform grain boundary. DOE

N92-18675# International Centre for Theoretical Physics, Trieste (Italy).
MULTIFRACTAL PROPERTIES OF DIFFUSION-LIMITED AGGREGATES AND RANDOM MULTIPLICATIVE PROCESSES
E. Canessa Apr. 1991 16 p
(DE92-603753; IC-91/83) Avail: NTIS HC/MF A03

We consider the multifractal properties of irreversible diffusion-limited aggregation (DLA) from the point of view of the self-similarity of fluctuations in random multiplicative processes. In particular, we analyze the breakdown of multifractal behavior and phase transition associated with the negative moments of the growth probabilities in DLA. DOE

N92-18713# Tennessee Technological Univ., Cookeville. Dept. of Physics.
PROTON RESONANCE SPECTROSCOPY
J. F. Shriner, Jr. Nov. 1991 28 p
(Contract DE-FG05-87ER-40353)
(DE92-004059; DOE/ER-40353/9) Avail: NTIS HC/MF A03

This report discusses the following topics: Complete Level Scheme for O-30; A Search for Resonances Suitable for Tests of Detailed-Balance Violation; The Fourier Transform as a Tool for Detecting Chaos; Entrance Channel Correlations in p + Al-27; The Parity Dependence of Level Densities in V-49; and A Computer Program for the Calculation of Angular Momentum Coupling. DOE

N92-18742# Los Alamos National Lab., NM.
VIBRATIONAL SPECTROSCOPY IN HIGH TEMPERATURE DENSE FLUIDS
D. S. Moore and S. C. Schmidt 1992 8 p Presented at the Society of Photo-Optical Instrumentation Engineers' International Symposium on Laser Spectroscopy as Part of SPIE's Symposium on Optics, Electro-Optics and Laser Applications in Science and Engineering, Los Angeles, CA
(Contract W-7405-eng-36)
(DE92-005052; LA-UR-91-4097; CONF-920124-3) Avail: NTIS HC/MF A02

Coherent anti-Stokes Raman spectroscopy (CARS) in conjunction with a two-stage light-gas gun has been used to obtain vibrational spectra of shock-compressed liquid N2, O2, CO, and their mixtures, as well as liquid N2O. The experimental spectra are compared to spectra calculated using a semiclassical model for CARS intensities to obtain vibrational frequencies, peak Raman susceptibilities, and linewidths. The derived spectroscopic parameters suggest thermal equilibrium of the vibrational populations is established in less than a few nanoseconds after shock passage. Vibrational temperatures obtained are compared to those derived from equation-of-state calculations. The variation of the vibrational frequency shift at pressure with species concentration in mixtures is investigated. DOE

N92-18806# Michigan State Univ., East Lansing. Dept. of Chemistry.
THE INFLUENCE OF PRESSURE ON SOLUTE RETENTION IN LIQUID CHROMATOGRAPHY
V. L. McGuffin and C. E. Evans 1991 11 p Presented at the International Symposium on Capillary Chromatography, Riva del Garda, Italy, 13-16 May 1991
(Contract DE-FG02-89ER-14056)
(DE92-004017; DOE/ER-14056/10; CONF-9105293-1) Avail: NTIS HC/MF A03

In this investigation, multiple on-column detectors are utilized to measure the retention of model solutes directly on a packed, capillary column. The absolute pressure on the column is controlled using a restrictor at the column exit, while the pressure gradient and volumetric flowrate are maintained constant. Measurements obtained under reversed-phase conditions indicate that the local capacity factor changes considerably with local pressure under typical operating conditions. These results are somewhat surprising since the mobile-phase solvents used for liquid chromatography are generally considered to be incompressible. DOE

26 METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

N92-18020# International Centre for Theoretical Physics, Trieste (Italy).
ANALYTIC NEAREST NEIGHBOUR MODEL FOR FCC METALS

J. O. A. Idiodi, E. J. D. Garba, and O. Akinlade Jun. 1991 18 p
(DE92-609234; IC-91/122) Avail: NTIS HC/MF A03

A recently proposed analytic nearest-neighbor model for fcc metals is criticized and two alternative nearest-neighbor models derived from the separable potential method (SPM) are recommended. Results for copper and aluminum illustrate the utility of the recommended models. DOE

N92-18056# California Univ., Berkeley. Lawrence Berkeley Lab.
HREM IMAGING OF SINGLE UNIT CELL CARBIDE PRECIPITATES IN Pt-C ALLOYS
M. J. Witcomb (Witwatersrand Univ., Johannesburg, South Africa), U. Dahmen, M. A. OKeefe, and K. H. Westmacott Jul. 1991 2 p Presented at the 49th Electron Microscopy Society of America (EMSA) Annual Meeting, San Jose, CA, 4-9 Aug. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004320; LBL-30693; CONF-910870-24) Avail: NTIS HC/MF A01

Dilute Pt-C alloys are prototypical for studying oversize carbide phase precipitation from interstitial solid solution. Earlier studies showed the essential function of quenched-in vacancies in the precipitation process. Vacancies play a dual volume accommodation and structural role in the transformation by modifying both the habit plane spacing and stacking sequence. It was also shown how the precipitation sequence in interstitial Pt-C alloys is analogous to that in substitutional Al-Cu alloys, initially a 'GP zone' consisting of a monolayer plate of carbon atoms and vacancies forms. Atomic resolution images of the so-called alpha precipitates have confirmed their structure. During subsequent coarsening of the precipitates, alpha (prime) platelets form. The single-layer alpha structure, or GP zone is identical to a (100) stacking fault stabilized by an intercalation of carbon. The two-layer alpha (prime) structure is the first true precipitate phase and has a crystal structure anti-isomorphous with calcium fluoride. In the present contribution, simulated images based on this structure are compared with experimental images obtained at 800kV on the JEOL-1000 ARM. In addition to confirming the proposed precipitate structure, the results show the potential for successful imaging of precipitate structures containing light elements. DOE

N92-18078# Army Armament Research, Development and Engineering Center, Watervliet, NY.
ABSENCE OF EXTERNAL ELECTRIC-FIELD EFFECTS ON TRANSFORMATIONS IN STEELS Final Report
P. J. Cote, L. V. Meisel, and T. Hickey Oct. 1991 29 p
(AD-A243419; ARCCB-TR-91032) Avail: NTIS HC/MF A03
CSCL 11/6

Large hardness increases were recently reported for an ASTM A723 and an O2 tool steel when a 1 kV/cm external electric (E)-field was applied during the post-austenitization quench. The increased hardness was attributed to a field-induced order of magnitude decrease in the austenite decomposition rate during the quench. The results of an extensive study of austenite decomposition kinetics in the same A723 steel and a similar O2 tool steel in the presence and absence of E-fields with magnitudes up to 3 kV/cm during post-austenitization cooling are reported here. Differential thermal analysis and thermomagnetic analysis were employed to directly monitor the austenite decomposition processes in both steels. Supplementary hardness measurements in the tool steel are also reported. No effects of external E-fields on austenite transformations were detected. GRA

N92-18101# California Univ., Irvine. Dept. of Chemistry.
SYNTHESIS AND CHEMISTRY OF YTTRIUM AND LANTHANIDE METAL COMPLEXES
W. J. Evans Sep. 1991 8 p
(Contract DE-FG03-86ER-13514)
(DE92-003767; DOE/ER-13514/T1) Avail: NTIS HC/MF A02

The objective of this research project is to determine the special features of complexes of yttrium and the lanthanide metals which will allow the design and synthesis of materials with unique chemical, physical, and catalytic properties. Past studies of yttrium and lanthanide metal alkyl and hydride complexes stabilized by cyclopentadienyl co-ligands have shown that a substantial, often singular, organometallic chemistry is available via these metals. More extensive utilization of the chemical opportunities available through yttrium and the lanthanides would be possible, however, if stabilizing ancillary ligand systems less sensitive to oxidation and protonolysis than cyclopentadienides could be developed. Alkoxide ligands are attractive in this regard and our recent research focused on alkoxides and the special opportunities they can provide to these metals. DOE

N92-18157# Argonne National Lab., IL.
ACTIVATION ANALYSES FOR DIFFERENT FUSION STRUCTURAL ALLOYS
H. Attaya and D. Smith 1991 17 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-004143; ANL/CP-70626; CONF-911111-13) Avail: NTIS HC/MF A03

The leading candidate structural materials, viz., the vanadium alloys, the nickel or the manganese stabilized austenitic steels, and the ferritic steels, are analyzed in terms of their induced activation in the TPSS fusion power reactor. The TPSS reactor has 1950 MW fusion power and inboard and outboard average neutron wall loading of 3.75 and 5.35 MW/sq m respectively. The results show that, after one year of continuous operation, the vanadium alloys have the least radioactivity at reactor shutdown. The maximum difference between the induced radioactivity in the vanadium alloys and in the other iron-based alloys occurs at about 10 years after reactor shutdown. At this time, the total reactor radioactivity, using the vanadium alloys, is about two orders of magnitude less than the total reactor radioactivity utilizing any other alloy. The difference is even larger in the first wall, the FW-vanadium activation is 3 orders of magnitude less than other alloys' FW activation. DOE

N92-18178# University of Southern California, Los Angeles. Dept. of Chemistry.
CHEMISTRY OF BIMETALLIC AND ALLOY SURFACES
B. E. Koel 18 Oct. 1991 11 p
(Contract DE-FG03-90ER-14117)
(DE92-003762; DOE/ER-14117/T1) Avail: NTIS HC/MF A03

In the first funding period, we continued our work on elucidating the underlying principles that govern chemical reactions occurring on bimetallic and alloy surfaces. Our goal is to aid in the atomic level explanation of the reactivity and selectivity of alloy and bimetallic cluster catalysts and to provide a fundamental basis for the design of new catalysts with improved performance. Our approach is to use a battery of surface science methods to obtain fundamental data on the thermochemistry and kinetics of the adsorption and reaction of molecules on extensively characterized, single-crystal bimetallic surfaces. We measure changes in chemisorption bond strengths, adsorption site distributions, and hydrocarbon fragment stability and reactivity and correlate these results with the geometric and electronic structure of the metal atoms on the surface. Often, our aim is to carefully design experiments that isolate the several factors (e.g., ensemble and ligand effects) that control surface chemistry and catalysis on bimetallic and alloy surfaces in order to better understand the importance of each contribution. Some of the highlights and noteworthy accomplishments made during the first period of this grant are given. DOE

N92-18180# University of Southern California, Los Angeles. Dept. of Chemistry.
CHEMISTRY OF BIMETALLIC AND ALLOYS SURFACES
B. E. Koel 18 Oct. 1991 6 p
(Contract DE-FG03-90ER-14117)
(DE92-004337; DOE/ER-14117/T2) Avail: NTIS HC/MF A02

We have continued our work on elucidating the underlying principles that govern chemical reactions occurring on bimetallic

and alloy surfaces. Our goal is to aid in the atomic level explanation of the reactivity and selectivity of alloy and bimetallic cluster catalysts and to provide a fundamental basis for the design of new catalysts with improved performance. Our approach is to use a battery of surface science methods to obtain fundamental data on the thermochemistry and kinetics of the adsorption and reaction of molecules on extensively characterized, single-crystal bimetallic surfaces. We measure changes in chemisorption bond strength, adsorption site distributions, and hydrocarbon fragment stability and reactivity and correlate these results with the geometric and electronic structure of the metal atoms on the surface. Often, our aim is to carefully design experiments that isolate the several factors (e.g., ensemble and ligand effects) that control surface chemistry and catalysis on bimetallic and alloy surfaces in order to better understand the importance of each contribution. In the past 18 months, we have continued to study how alkali promoters strongly affect the reactions of hydrocarbons on Pt and Ni surfaces by altering the electronic structure and inducing significant site-blocking effects. We have shown that bismuth coadsorption provides benchmark data on ensemble sizes required for chemical reactions on Pt and Ni surfaces. Surface alloys of Sn/Pt are being used for detailed probing of ensemble sizes and also reactive site requirements. DOE

N92-18189*# Virginia Univ., Charlottesville. Dept. of Materials Science and Engineering.

NASA-UVA LIGHT AEROSPACE ALLOY AND STRUCTURES TECHNOLOGY PROGRAM (LA(SUP 2)ST) Progress Report, 1 Jul. - 31 Dec. 1991

Richard P. Gangloff, John K. Haviland, Carl T. Herakovich, Walter D. Pilkey, Marek-Jerzy Pindera, John R. Scully, Edgar A. Starke, Jr., Glenn E. Stoner, Earl A. Thornton, and Franklin E. Wawner, Jr. et al 30 Jan. 1992 265 p

(Grant NAG1-745)

(NASA-CR-187803; NAS 1.26:187803; SEAS-UVA/528266/MS92/109) Avail: NTIS HC/MF A12 CSCL 11F

The general objective of the Light Aerospace Alloy and Structures Technology (LA(sup 2)ST) Program is to conduct interdisciplinary graduate student research on the performance of next generation, light weight aerospace alloys, composites, and thermal gradient structures in collaboration with Langley researchers. Specific technical objectives are established for each research project. We aim to produce relevant data and basic understanding of material behavior and microstructure, new monolithic and composite alloys, advanced processing methods, new solid and fluid mechanics analyses, measurement advances, and critically, a pool of educated graduate students for aerospace technologies. Four research areas are being actively investigated, including: (1) Mechanical and Environmental Degradation Mechanisms in Advanced Light Metals and Composites; (2) Aerospace Materials Science; (3) Mechanics of Materials and Composites for Aerospace Structures; and (4) Thermal Gradient Structures. Author

N92-18199# Oak Ridge National Lab., TN.

EFFECTS OF THERMAL AGING AND NEUTRON IRRADIATION ON THE MECHANICAL PROPERTIES OF STAINLESS STEEL WELD OVERLAY CLADDING

F. M. Haggag and R. K. Nanstad 1991 6 p Presented at the 5th International Symposium on Environmental Degradation on Materials in Nuclear Power Systems-Water Reactors, Monterey, CA, 25-29 Aug. 1991

(Contract DE-AC05-84OR-21400)

(DE92-004443; CONF-910808-7) Avail: NTIS HC/MF A02

Stainless steel weld overlay cladding was fabricated using the three-wire, series-arc method. Three layers of cladding were applied to a pressure vessel plate to provide adequate thickness for fabrication of test specimens. Since irradiation of the stainless steel cladding to 5 times 10(exp 19) neutrons/cm(exp 2) (greater than 1 MeV) was conducted at 288 C for 1605 h, tensile, Charpy V-notch (CVN), precracked Charpy V-notch (PCVN), and compact fracture toughness specimens were thermally aged at 288 C for 1605 h. Additional specimens are being aged to 20,000 and 50,000 h. Thermal aging of three-wire, series-arc stainless steel weld overlay cladding at 288 C for 1604 h resulted in appreciable decrease (16 percent) in the CVN upper-shelf energy, but the effect on the 41-J transition temperature shift was very small (3 C). The combined effect, following neutron irradiation at 288 C to a fluence of 5 times 10(exp 19) neutrons/cm(exp 2) (greater than MeV), was a 22 percent reduction in the CVN upper-shelf energy and a 29 C shift at the 41-J level. The effect of thermal aging on tensile properties was very small or negligible. However, the combined effect after neutron irradiation was an increase in the yield strength (6 to 34 percent at test temperatures from 288 to minus 125 C) and no apparent change in ultimate strength and total elongation. Also, neutron irradiation reduced the initiation fracture toughness (J sub Ic) much more than did thermal aging. However, irradiation slightly decreased the tearing modulus, but no reduction was caused by thermal aging alone. The effects of long-term thermal exposure times (20,000 and 50,000 h) will be investigated when the specimen become available. DOE

N92-18328# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Central Labs.

DEVELOPMENT OF DIFFUSION BONDING TECHNIQUES FOR Al-Li BASE ALLOY AA8090

R. A. Ricks, G. J. Mahon, N. C. Parson (Alcan International Ltd., Banbury, England), T. Heinrich, and P.-J. Winkler 1990 14 p Presented at the Conference on Diffusion Bonding, Cranfield, England, 28-29 Mar. 1990

(MBB-Z-0355-90-PUB; ETN-92-90606) Avail: NTIS HC/MF A03

Bond strengths of Al-Li base AA8090 alloys are tested. It is concluded that the bond strengths developed in the alloys will fall short of parent metal strength if bonding conditions similar to those used in the investigation are used. The solid state bonding experiments show that the method of strength assessment used is important when comparing relative bonding technology suitability. It is recommended that shear strength data is not used as a standard assessment of bond strength and reliability owing to the possibility of recording very high shear strength values for bonds which may have almost no tensile peel strength. ESA

N92-18391# Pittsburgh Univ., PA. Dept. of Materials Science and Engineering.

MICROCHEMICAL ANALYSIS OF INTERMETALLIC ALLOYS USING THE FIELD-ION MICROSCOPE ATOM PROBE Final Report

S. S. Brenner 1 Sep. 1991 7 p

(Contract DE-FG02-85ER-45213)

(DE92-004020; DOE/ER-45213/T2) Avail: NTIS HC/MF A02

In this final report, we summarize the results of our studies on Ni3Al. Additionally, we comment on the future use of field-ion microscopy techniques to elucidate the ductilization effect of boron. DOE

N92-18395# Minnesota Univ., Minneapolis.

MODELING AND EXPERIMENTAL STUDIES OF OXIDE COVERED METAL SURFACES: TiO2/Ti A MODEL SYSTEM

W. H. Smyrl 1991 57 p

(Contract DE-FG02-88ER-45338)

(DE92-004053; DOE/ER-45338/1) Avail: NTIS HC/MF A04

Prior work in our laboratories at the Corrosion Research Center has shown that thin, anodic TiO2 films formed by the Slow Growth Mode (SGM) on polycrystalline titanium are microcrystalline with a texture that varies from one metal grain to another. Furthermore, the underlying metal grains are mapped by the photoelectrochemical response of the oxide. The same characteristics have also been demonstrated in our laboratory for ZnO grown on Zn. The TiO2/Ti system was chosen for its importance in energy systems, and because it can serve as a model system for other metal-metal oxide couples. The investigations of anodic TiO2 films on Ti have shown that the properties of thin films are consistent with the rutile form of the oxide. Both experimental data and theoretical calculations show the close resemblance to results on single crystal TiO2.

Furthermore, the modeling studies reveal that the optical transitions near the band edge arise from the bulk band structure. The photoelectrochemical properties of anodic TiO2 films have now been shown to obey the simple Gaertner-Butler model for the semiconductor-electrolyte interface, with a few modifications. The most important deviation was shown to be a result of multiple internal reflections in the oxide film. DOE

N92-18425# International Centre for Theoretical Physics, Trieste (Italy).
ANALYSIS OF THE TIGHT-BINDING DESCRIPTION OF THE STRUCTURE OF METALLIC 2D SYSTEMS
R. Baquero Dec. 1990 11 p
(DE92-603734; IC-90/443) Avail: NTIS HC/MF A03

Bidimensional metallic systems as interfaces, quantum wells and superlattices with sharp interfaces became recently available and their properties can now be experimentally studied in detail. To calculate the Local Density of States (LDOS) for surfaces, interfaces, quantum wells and superlattices, we use empirical tight-binding Hamiltonians together with the Green function matching method (GFM). In this paper we show some examples of our results employing the method just outlined to describe metallic 2D systems. In particular, we refer briefly to the effect on the LDOS of the very recently established contraction of the first interatomic layer distance in the Ta(001) surface. We then discuss the Nb-V ideal (100) interface and conclude that under certain conditions the V-side of an interface can show magnetism as the V(001) surface does. As a last example, we present a calculation that relates the changes with gold coverage of the reaction rate of the catalytic reaction of cyclohexene into benzene on a Pt(001) surface to the changes on the LDOS of the outermost Pt atomic layer. We show that the behavior of the LDOS around the Fermi level is an important factor to the explanation of the behavior of this catalytic reaction. We conclude by stating that the empirical tight-binding method is a very simple and useful tool for the description of 2D metallic systems. The advantage is that the computational demands are low and all the ingredients to take full profit of this method are available (reliable tight-binding parameters and suitable methods for the calculation of the Green function). DOE

N92-18493# International Centre for Theoretical Physics, Trieste (Italy).
COMPLEXES IN POLYVALENT METAL: ALKALI HALIDE MELTS
Z. Akdeniz and M. P. Tosi Mar. 1991 7 p
(DE92-604190; IC-91/35) Avail: NTIS HC/MF A02

Experimental evidence is available in the literature on the local coordination of divalent and trivalent metal ions by halogens in some 140 liquid mixtures of their halides with alkali halides. After brief reference to classification criteria for main types of local coordination, we focus on statistical mechanical models that we are developing for Al-alkali halide mixtures. Specifically, we discuss theoretically the equilibrium between (AlF6)(3-) and (AlF4)(1-) complexes in mixtures of AlF3 and NaF as a function of composition in the NaF-rich region, the effect of the alkali counterion on this equilibrium, the possible role of (AlF5)(2-) as an intermediate species in molten cryolite, and the origin of the different complexing behaviors of Al-alkali fluorides and chiorides. We also present a theoretical scenario for processes of structure breaking and electron localization in molten cryolite under addition of sodium metal. DOE

N92-18495# Israel Atomic Energy Commission, Beersheba. Nuclear Research Center.
ELEMENTAL SEGREGATION IN TITANIUM ALLOYS INDUCED BY PLASMA-SURFACE INTERACTION Ph.D. Thesis - Ben Gurion Univ. of the Negev
A. Raveh Jul. 1990 159 p In HEBREW; ENGLISH summary
(DE92-604584; NRCN-606) Avail: NTIS HC/MF A08

The microstructure and surface composition of nitrided titanium alloys (Ti-6Al-4V and Ti-8Al-1V-Mo) were investigated after plasma nitriding with nitrogen, hydrogen, and argon. The composition of the plasma, near the surface of the sample (plasma layer), was examined by optical emission spectroscopy and mass spectrometry, while the composition of the surface of the alloy after the process, the structure, and microstructure of the layers were studied by auger electron spectrometry, scanning auger microprobe, x-ray diffraction, scanning electron microscope, transmission electron microscope, and high resolution transmission electron microscope. It was observed that elemental segregation occurs in titanium alloys at the interface between compound layer and diffusion layer. Based on the present results, a mechanism for the formation of the nitrided layers in the plasma was suggested. DOE

N92-18541# Pacific Northwest Lab., Richland, WA.
SENSITIZATION AND IGSCC SUSCEPTIBILITY PREDICTION IN STAINLESS STEEL PIPE WELDMENTS
D. G. Atteridge, J. W. Simmons, Ming Li (Oregon Graduate Inst. of Science and Technology, Beaverton.), and S. M. Bruemmer Nov. 1991 27 p Presented at the Life Prediction of Corrodible Structures, Kauai, HI, 5-8 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-004509; PNL-SA-20244; CONF-911179-2) Avail: NTIS HC/MF A03

An analytical model, based on the prediction of chromium depletion, has been developed for predicting thermomechanical effects on austenitic stainless steel intergranular stress corrosion cracking (IGSCC) susceptibility. Model development and validation is based on sensitization development analysis of over 30 Type 316 and 304 stainless steel heats. The data base included analysis of deformation effects on resultant sensitization development. Continuous cooling sensitization behavior is examined and modelled with and without strain. Gas tungsten arc (GTA) girth pipe weldments are also characterized by experimental measurements of heat affected zone (HAZ) temperatures, strains and sensitization during/after each pass; pass by pass thermal histories are also predicted. The model is then used to assess pipe chemistry changes on IGSCC resistance. DOE

N92-18542# Pacific Northwest Lab., Richland, WA.
IRRADIATION PERFORMANCE OF OXIDE DISPERSION STRENGTHENED COPPER ALLOYS TO 150 dpa AT 415 C
D. J. Edwards, A. S. Kumar, K. R. Anderson, J. F. Stubbins (Illinois Univ., Urbana.), F. A. Garner, and M. L. Hamilton Nov. 1991 17 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contracts DE-AC06-76RL-01830; DE-FG06-89ER-75522)
(DE92-004511; PNL-SA-19386; CONF-911111-17) Avail: NTIS HC/MF A03

Results have been obtained on the post-irradiation properties of various oxide dispersion strengthened copper alloys irradiated from 34 to 150 dpa at 415 C in the Fast Flux Test Facility. The GlidCop alloys strengthened by Al2O3 continue to outperform other alloys with respect to swelling resistance, and retention of both electrical conductivity and yield strength. Several castable ODS alloys and a Cr2O3 strengthened alloy show increasingly poor resistance to radiation, especially in their swelling behavior. A HfO2 strengthened alloy retains most of its strength and its electrical conductivity reaches a constant level after 50 dpa, but it exhibits a higher residual radioactivity. DOE

N92-18556# Allied-Signal Aerospace Co., Kansas City, MO.
POTENTIOMETRIC ANALYSIS OF WATER SOLUBLE CUTTING FLUID-METAL COMBINATIONS
E. E. Kelley Dec. 1991 57 p
(Contract DE-AC04-76DP-00613)
(DE92-004882; KCP-613-4508) Avail: NTIS HC/MF A04

The results of corrosion studies conducted by the University of Kansas under Contract G257763 for Allied-Signal Inc., Kansas City Division (KCD), are given. These potentiometric studies evaluate the corrosivity of two water soluble cutting fluids at varying concentrations on samples of 304 stainless steel, 6061-T6 aluminum, and beryllium copper. This testing serves two purposes: (1) to develop effective test procedures adaptable to existing KCD corrosion measurement equipment for corrosion analysis of cutting

fluid-metal combinations; and (2) to understand the relative corrosiveness of the varying water soluble cutting fluids on different metals. The tests used were adapted from the American Society of Testing Materials (ASTM). Future testing will identify polarization techniques for establishing corrosion rates which will be used in evaluating both water soluble cutting fluids and other aqueous solutions used at KCD. DOE

N92-18562# Oregon Graduate Inst. of Science and Technology, Beaverton.
DEFORMATION INDUCED MICROSTRUCTURAL AND MICROCHEMICAL CHANGES DURING THERMOMECHANICAL TREATMENT
D. G. Atteridge, L. E. Murr, W. E. Wood, and S. M. Bruemmer (Pacific Northwest Lab., Richland, WA.) 1990 150 p
(Contract DE-AC06-86NE-37963)
(DE92-004394; DOE/NE-37963/17) Avail: NTIS HC/MF A07

An important aspect of this program has been the continued study into: the effects of solution annealing (SA) on the subsequent susceptibility of the stainless steel (SS) material to grain boundary chromium depletion (GBCD); the effects of deformation on SA material and on the subsequent susceptibility of the deformed SS material to GBCD; the effects of deformation on isothermally induced GBCD in mill annealed (MA) and SA SS material; and, modeling the effects of deformation on isothermally induced GBCD in MA and SA SS material. An understanding of these subjects are academically important to this program as well as commercially important to the industrial community. This annual report presents an overview of programmatic research to data in these areas. DOE

N92-18566# Pacific Northwest Lab., Richland, WA.
RESPONSE OF SOLUTE AND PRECIPITATION-STRENGTHENED COPPER ALLOYS AT HIGH NEUTRON EXPOSURE
F. A. Garner, M. L. Hamilton, T. Shikama, D. J. Edwards, and J. W. Newkirk (Missouri Univ., Rolla.) Nov. 1991 23 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract DE-AC06-76RL-01830)
(DE92-004504; PNL-SA-19387; CONF-911111-14) Avail: NTIS HC/MF A03

A variety of solute and precipitation strengthened copper base alloys have been irradiated to neutron induced displacement levels of 34 to 150 dpa at 415 C and 32 dpa at 529 C in the Fast Flux Test Facility to assess their potential for high heat flux applications in fusion reactors. Several MZC-type alloys appear to offer the most promise for further study. For low fluence applications, CuBeNi and spinodally strengthened CuNiTi alloys may also be suitable. Although Cu-2Be resists swelling, it is not recommended for fusion reactor applications because of its low conductivity. DOE

N92-18699# Oregon Graduate Inst. of Science and Technology, Beaverton.
DEFORMATION INDUCED MICROSTRUCTURAL AND MICROCHEMICAL CHANGES DURING THERMOMECHANICAL TREATMENT
D. G. Atteridge, W. E. Wood, and S. M. Bruemmer (Pacific Northwest Lab., Richland, WA.) 1991 31 p
(Contract DE-AC06-86NE-37963)
(DE92-004392; DOE/NE-37963/18) Avail: NTIS HC/MF A03

This quarter's effort has been directed towards development and assessment of the capability to predict sensitization development, in particular, sensitization development during continuous cooling. Model predictions are first compared to a continuous cooling (plus prestrain) data base developed under Nuclear Regulatory Commission funding. Parallel model development allowed prediction of weld thermal histories, assessment of weld induced sensitization, and prediction of weldment susceptibility to intergranular stress corrosion cracking (IGSCC). It has long been known that IGSCC of austenitic Type 300 Series stainless steels (SS) is directly related to the presence of grain boundary chromium depletion, and that this depletion, also called 'sensitization', is caused by the formation of grain boundary chromium carbides/nitrides. Thus is is well documented that susceptibility to IGSCC is caused by a diffusion controlled process. However, quantification of this phenomena is still on active research area, and the research reported herein pertains to the development of a computer based model capable of predicting IGSCC susceptibility in the heat affected zone (HAZ) of Type 304 and 316 SS girth pipe weldments. Model predictions are based on prediction of chromium depletion at grain boundaries. It is assumed that as grain boundary sensitization increases susceptibility to IGSCC increases. The model predicts levels of sensitization, with susceptibility to IGSCC estimated on a system by system assessment. DOE

N92-18700# Sandia National Labs., Albuquerque, NM.
WETTABILITY ANALYSIS OF TIN-BASED, LEAD FREE SOLDERS
P. T. Vianco, F. M. Hosking, and J. A. Rejent 1992 14 p Presented at the National Electronics Products Conference (NEPCON) West, Anaheim, CA, 23-27 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004397; SAND-91-2752C; CONF-920247-3) Avail: NTIS HC/MF A03

The overall program is comprised of two efforts. The first effort studies the wettability of tin-based, lead free solders on two commonly used substrate materials: copper and gold-nickel plated Kovar(trademark). The evaluation is being conducted by the meniscometer/wetting balance technique which uses the contact angle as the primary metric to quantify wettability. Information about the rate of wetting is also obtainable with this test. The second part of the program is comprised of an assessment of the solderability of actual circuit board assemblies (surface mount and through-hole). This report will describe data from the wettability analysis of lead free solders on copper. DOE

N92-18726# State Univ. of New York, Stony Brook.
ATOMIC AND ELECTRONIC STRUCTURE OF METALS AND ALLOYS: CLEAN SURFACES AND CHEMISORBED MOLECULES
26 Nov. 1991 8 p
(Contract DE-FG02-86ER-45239)
(DE92-005075; DOE/ER-45239/7) Avail: NTIS HC/MF A02

The accomplishments of the work done under DOE sponsorship are summarized in the list of publications at the end of this narrative. Here we give a brief description of the nature and the significance of the accomplishments. The activity can be roughly subdivided into three parts: studies of surface alloys, studies of epitaxial ultra-thin films, and studies of electron band structure of metals. The list reflects the developments of particular areas of research and the phasing out of others as this was suggested by the interest in, and the success of, specific experimental projects. DOE

N92-18737# California Univ., Berkeley. Lawrence Berkeley Lab.
CONTROL OF TEXTURE DURING VAPOR DEPOSITION OF Al ON (111) Si
N. Thangaraj, K. H. Westmacott, U. Dahmen, and J. Reyes-Gasga (Universidad Nacional Autonoma de Mexico, Mexico City.) Apr. 1991 6 p Presented at the Spring Meeting of the Materials Research Society (MRS), Anaheim, CA, 29 Apr. - 3 May 1991
(Contract DE-AC03-76SF-00098)
(DE92-004168; LBL-30729; CONF-910406-39) Avail: NTIS HC/MF A02

The growth of Al on (111) Si single crystal substrates by various techniques usually leads to films with (111) texture, sometimes with a small (100) component. Using X-ray diffraction and electron microscopy, the present study shows that the (100) texture component can be enhanced to the point of forming an oriented (100) continuous tricrystal structure. The formation of this texture is shown to be related to the presence of Cu. It is concluded that an understanding of heteroepitaxy must take into account the effect of chemistry in addition to the crystallographic criteria of lattice matching. DOE

N92-18843# Washington State Univ., Pullman.
INVESTIGATIONS OF CHARGE-SEPARATION PROCESSES IN METAL COMPLEXES
G. A. Crosby 18 Feb. 1991 9 p
(Contract DE-FG06-87ER-13809)
(DE92-004327; DOE/ER-13809/T1) Avail: NTIS HC/MF A02

The major thrust of the research has been the quantification of the excited states of inorganic complexes that display potential for mediating charge separation processes. Investigations of copper(1) mixed ligand complexes have been completed. Non-equilibrated emitting states have been assigned. Chemical tuning of the emission energy by modifying the basicity of the donor ligand on the metal has been achieved. Structure property relationships have been defined for crystalline complexes of zinc containing both diimine and monothiol ligands. Correlation of the spectral shifts with the rotations of the thiol phenyl rings in different crystal phases has been shown by comparing with extended Huckel calculations and x ray structures. Complexes of zinc containing diimine and dithiol ligands are shown to be polynuclear species. A trinuclear species can be forced to assume a binuclear structure by incorporating other non-coordinating ligands into the lattice. The transformation is accompanied by substantial photophysical changes. Syntheses and x ray structure determinations of platinum(2) complexes containing diimine ligands only, both diimine and dithiol ligands, and dithiol ligands only have been completed. An unusual platinum(3) bis(dithiol) species has been obtained and its structure determined. Investigations of the emission spectra of bis(bipyridine)platinum(2) have revealed the existence of multiple emitting states with both ligand localized and charge transfer characteristics. DOE

N92-18851# Colorado School of Mines, Golden.
CRACKING BEHAVIOR OF CORED STRUCTURES
A. Wahid, D. L. Olson, D. K. Matlock, and T. J. Kelly 1991 7 p
Presented at the 1st International Conference on Heat Resistant Materials, Lake Geneva, WI, 22-26 Sep. 1991
(Contract DE-FG02-87ER-45308)
(DE92-005193; CONF-910909-13) Avail: NTIS HC/MF A02

The effects of compositional gradients are considered based on a thermodynamic analysis, referred to as the Cahn-Hillard analysis, which describes the degree to which a local surface energy is modified by the presence of a composition gradient. The analysis predicts that both ductile and brittle fracture mechanisms are enhanced by the presence of a composition gradient. Data on stress corrosion cracking and fatigue crack growth in selected FCC alloys are used to illustrate the significance of microsegregation on mechanical properties. DOE

N92-18886*# National Inst. of Standards and Technology, Gaithersburg, MD. Applied and Computational Mathematics Div.
PHASE-FIELD MODEL FOR ISOTHERMAL PHASE TRANSITIONS IN BINARY ALLOYS
A. A. Wheeler (Bristol Univ., England), W. J. Boettinger, and G. B. McFadden Aug. 1991 52 p Sponsored by NASA, Washington; Science Research Council; Royal Society; DARPA; and NATO
(NASA-CR-189945; NAS 1.26:189945; PB92-108992; NISTIR-4662) Avail: NTIS HC/MF A04 CSCL 11F

A new phase field model is described which models isothermal phase transitions between ideal binary alloy solution phases. Equations are developed for the temporal and spatial variation of the phase field, which describes the identity of the phase, and of the composition. An asymptotic analysis, as the gradient energy coefficient of the phase field becomes small, was conducted. From the analysis, it is shown that the model recovers classical sharp interface models of this situation when the interfacial layers are thin, and they show how to relate the parameters appearing in the phase field model to material and growth parameters in real systems. Further, three stages of temporal evolution are identified: the first corresponding to interfacial genesis which occurs very rapidly; the second to interfacial motion controlled by the local energy difference across the interface and diffusion; the last taking place on a long time scale in which curvature effects are important and which correspond to Ostwald ripening. The results of the numerical calculations are presented. Author

N92-18894# National Aerospace Lab., Amsterdam (Netherlands). Structures and Materials Div.
FRACTURE AND FATIGUE EVALUATION OF DAMAGE TOLERANT Al-Li ALLOYS FOR AEROSPACE APPLICATIONS
R. J. H. Wanhill, L. Schra, and W. G. J. tHart Jan. 1990 19 p Presented at the 8th European Conference on Fracture, Turin, Italy, 1-5 Oct. 1990 Sponsored by Netherlands Agency for Aerospace Programs
(NLR-TP-90132-U; ETN-92-90970) Avail: NTIS HC/MF A03

Extensive testing and evaluation requirements in the qualification of AlLi alloys for damage tolerant aerospace structures is addressed. Emphasis is on fracture and fatigue crack properties of two candidate sheet alloys, 2091 and 8090, compared with the conventional and widely used 2024 alloy. The relative merits of these materials are assessed, problem areas are indicated, and a survey is made of the type of qualification program necessary for damage tolerant AlLi aerospace structures. ESA

N92-18914# Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium).
[ACTIVITIES REPORT OF THE CENTER FOR SCIENTIFIC AND TECHNICAL RESEARCH IN THE METALLIC FABRICATION INDUSTRY] Annual Report, 1990 [CENTRE DE RECHERCHES SCIENTIFIQUES ET TECHNIQUES DE L'INDUSTRIE DES FABRICATIONS METALLIQUES. RAPPORT ANNUEL 1990]
1991 66 p In FRENCH
(ISSN-0524-7705; ETN-92-90664) Avail: NTIS HC/MF A04

The work carried out in research and development in foundry work is described. Recuperation of old sand, metal treatments within a jet flow and simulation of solidification are three of the research areas studied. Research and development in metallic construction is presented. Stability of metal frames and their interaction with double layer steel panels is discussed. Research and development in welding and quality control of composite structures and materials is described. The characterization of reinforced plastics by means of nondestructive tests is described. ESA

N92-18936# Columbia Univ., New York, NY. Center for Strategic Materials.
A FUNDAMENTAL UNDERSTANDING OF THE INTERFACIAL COMPATIBILITY IN HYBRID MATERIAL SYSTEMS Final Report, 1 Sep. 1986 - 30 Sep. 1991
Rene B. Testa and John K. Tien Oct. 1991 20 p
(Grant AF-AFOSR-0312-86; AF Proj. 2306)
(AD-A243825; AFOSR-91-0943TR) Avail: NTIS HC/MF A03 CSCL 11/6

Efforts in this program have focused on developing an understanding of the nature and kinetics of component interactions in hybrid material systems at elevated temperature. Previous work on the chemical interactions in tungsten fiber reinforced superalloys was expanded on to include the effect of matrix chemistry on fiber recrystallization kinetics. General studies to assess the kinetics and diffusion path behavior of metal intermetallic (W/Ni3Al) and intermetallic intermetallic (TiAl/Ni3Al) were also undertaken. A feasibility study for production of diffusion barrier layers via ion implantation were also conducted. In response to a controversy in the scientific community, the influence of fiber matrix interactions on the anomalous creep behavior of SiC/Al was investigated. GRA

27 NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials.

For composite materials see *24 Composite Materials.*

N92-18029# Los Alamos National Lab., NM.
LIQUID CRYSTAL POLYESTER THERMOSETS Patent Application
B. C. Benicewicz, inventor (to DOE) and A. E. Hoyt, inventor (to DOE) 4 Apr. 1990 25 p
(Contract W-7405-eng-36)
(DE92-003838; US-Patent-Appl-SN-504217; Patents-US-A7504217) Avail: NTIS HC/MF A03

The present invention relates to the field of curable liquid crystal polyester monomers and to thermoset liquid crystalline polyester compositions prepared therefrom. It is an object of this invention to provide curable liquid crystalline polyester materials. Another object of this invention is to provide a process of preparing curable liquid crystal polyester monomers. Yet another object of this invention is to provide liquid crystalline blends of polyester materials. It is a further object of this invention to provide thermoset liquid crystalline polyester compositions. It is a still further object of this invention to provide thermoset liquid crystalline polyester compositions having a high heat resistance. DOE

N92-18100# Pennsylvania Univ., Philadelphia. Board of Trustees.
MOLECULAR AND POLYMERIC CERAMIC PRECURSORS
L. G. Sneddon Aug. 1991 7 p
(Contract DE-FG02-87ER-13732)
(DE92-003694; DOE/ER-13732/4) Avail: NTIS HC/MF A02

The development of new methods for the production of complex materials is one of the most important problems in modern solid state chemistry and materials science. This project is attempting to apply the synthetic principles which have evolved from inorganic and organometallic chemistry to the production of technologically important non-oxide ceramics, such as boron nitride, boron carbide and metal borides. Our recent work has now resulted in the production of new polymer systems, including poly(B-vinylborazine), polyvinylpentaborane and polyborazylene, that have proven to be high yield precursors to boron-based ceramic materials. Current work is now directed toward the synthesis of new types of molecular and polymeric boron-containing species and on exploration of the solid state properties of the ceramics that have been produced in these studies. DOE

N92-18103# Arizona State Univ., Tempe.
SURFACES AND INTERFACES OF CERAMICS AND METALS FOR PERIOD JULY 1988-JUNE 1991
1991 39 p
(Contract DE-FG02-86ER-45228)
(DE92-004069; DOE/ER-45228/9) Avail: NTIS HC/MF A03

During this three-year grant period, our research program has been both expanded in its scope and established more firmly on knowledge of the basic materials involved. New techniques have been brought into play and these have allowed a more complete understanding of the nature and form of the surfaces of the oxide ceramics. There have been several surprising developments. One is the discovery of surface superlattice structures on surfaces of oxide crystals of oxide crystals (MgO, Al2O3, and TiO2). Unlike most of the surface-reconstruction superlattices reported in the surface science literature, these are not structures confined to ultra-high vacuum environments. They are formed by high temperature annealing in air or oxygen and are stable for extended periods of exposure to the atmosphere as well as in UHV, and hence may well be relevant to surface properties of the oxides under the conditions appropriate to many technological applications. DOE

N92-18108 Department of the Navy, Washington, DC.
PROCESS OF THREE DIMENSIONAL LITHOGRAPHY IN AMORPHOUS POLYMERS Patent
Mark F. Sonnenschein, inventor (to Navy) and Charles M. Roland, inventor (to Navy) 27 Aug. 1991 8 p Filed 29 Nov. 1989
Supersedes N90-25221 (28 - 19, p 2676), AD-D014500
(AD-D015142; US-Patent-5,043,251; US-Patent-Appl-SN-442815; US-Patent-Class-430-297) Avail: US Patent and Trademark Office CSCL 07/6

A process of three dimensional lithography in amorphous polymers to form an instantaneous, permanent image in the polymer by the steps of providing an undoped, non-crystalline layer or film of a polymer having a stable amorphous state under human operating conditions. Thin film is preferably poly(ethylene terphthalate) (PET), poly(aryl-ether- ether-ketone) (PEEK), poly(chloro- trifluoroethylene) (Kel-F), poly(carbonate) (i.e., LEXAN 9032), poly(sulfone), poly(methylmethacrylate (PMMA, or LUCITE)), a poly(cyanurate) such as bisphenol A dicyanate, or an epoxy (e.g., Epon 820). The film can be either self supporting or mounted on a substrate. The film is then covered (and optionally contacted) with a mask which serves to block the radiation from impinging on where no marking is desired. If the mask is in actual contact with the film, it is capable of also acting as a heat sink. Next, the film is exposed through the mask to radiation of sufficient intensity to cause ablation of the exposed areas of imparting a distinct, three-dimensional impression in the film. GRA

N92-18111 Materials Research Labs., Ascot Vale (Australia).
A COMPUTER PROGRAM FOR GENERATING DEFORMATION MECHANISM MAPS FOR POLYMERS
R. G. ODonnell Jul. 1991 21 p
(MRL-TN-592; AR-006-374) Copyright Avail: Issuing Activity

The deformation mechanism map is a means of representing the predominant mechanism of deformation within a material over a range of deformation conditions. This paper introduces a computer program which utilizes a number of theoretical models of deformation within amorphous polymers to identify 'fields' within extension rate - temperature space where particular deformation mechanisms operate. The program is able to delineate these fields using borders and include isobars to indicate stress levels. Very good correlation is seen between the computer generated mechanism map and experimental results for polyvinyl chloride (PVC). While in its present form the program is restricted to amorphous isotropic polymers, it can readily be extended to incorporate semicrystalline polymers or composites, as suitable deformation models become available. Author

N92-18122 Department of the Navy, Washington, DC.
ANTI-FOULING CASTABLE POLYMERS AND ANTI-FOULING POLYURETHANES AND SIMILAR MATERIALS Patent
Alexander Lebovits, inventor (to Navy), William L. Yaeger, inventor (to Navy), William B. Mercer, inventor (to Navy), and Timothy L. Dapp, inventor (to Navy) 26 Feb. 1991 6 p Filed 1 Sep. 1988
(AD-D015137; US-Patent-4,996,261; US-Patent-Appl-SN-239351; US-Patent-Class-525-131) Avail: US Patent and Trademark Office CSCL 07/6

This invention relates to polymeric materials, formable by casting at room temperature and having antifouling materials incorporated therein. It is the reaction product of (a) with polyether polyols and methylene bis(4-cyclohexyl) isocyanate, where (a) is a polymeric composition which is the reaction product of a distilled tri-butyltin oxide with a copolymer of either methyl methacrylate of methyl acrylate and, with methacrylic acid or acrylic acid in such proportions that 4 percent of the carbonyl groups remain unreacted. GRA

N92-18139# Lawrence Livermore National Lab., CA.
EDS ANALYSIS OF BROMINE IN POLYMERS
C. W. Price, E. F. Lindsey, and S. A. Letts 14 Mar. 1991 4 p
Presented at the 49th Electron Microscopy Society of America (EMSA) Annual Meeting, San Jose, CA, 4-9 Aug. 1991
(Contract W-7405-eng-48)
(DE92-004160; UCRL-JC-106873; CONF-910870-25) Avail: NTIS HC/MF A01

Design requirements for the Inertial Confinement Fusion

program at LLNL frequently require polymers to be modified with known amounts of dopants without seriously degrading the surface finish. Techniques such as x ray fluorescence permit reliable quantitative analyses of the dopants. However, our strong emphasis on surface finish requires frequent SEM examinations, and the need for rapid analyses instigated on evaluation of EDS to analyze bromine in the SEM. Brominated polymers based on polystyrene and a plasma deposited hydrocarbon with a composition of approximately CH(1.2) were analyzed. The analyses were performed using an optional thin window in a NORAN Micro-Z 2 Si(Li) EDS mounted on a Hitachi S-800 FESEM. The specimens were coated with palladium. Since the standard ZAF programs are ineffective for hydrocarbon-based materials, calibration curves were established using Br L sub alpha/C K sub alpha peak ratios. A cryogenic vacuum system on the FESEM significantly reduced detrimental effects of carbon contamination on the sensitivity of the C K sub alpha peak. Brominated polymers are susceptible to electron beam damage, so the extent of damage and its effect on the EDS analysis also had to be determined. DOE

N92-18160# Argonne National Lab., IL.
POLYMERIZATION OF IMMUNOGLOBULIN DOMAINS: A MODEL SYSTEM FOR THE DEVELOPMENT OF FACILITATED MACROMOLECULAR ASSEMBLY
F. J. Stevens and E. A. Myatt 1991 27 p Presented at the 2nd Foresight Conference on Molecular Nanotechnology, Palo Alto, CA, 7-9 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-004723; ANL/CP-74444; CONF-9111148-1) Avail: NTIS HC/MF A03

We have recently determined that monoclonal immunoglobulin light chains (Bence Jones proteins) are capable of reversible polymerization at room temperature. This property, as exhibited by immunoglobulin light chains (normally a component of an intact antibody molecule), may have novel implications for the development of 'molecular nanotechnology.' The polymerization capability of the immunoglobulin light chain is associated with the so-called variable domain of this molecule. The variable domain is a durable, compact beta sheet structure of molecular weight approximately 12,000. Most of the primary sequence variation is limited to one portion of the molecule, that portion associated with the contribution of immunoglobulin light chains to the recognition and binding of thousand of different antigens by antibodies. As a consequence of these variations, different light chains polymerize with different degrees of avidity, from negligible to extensive. The polymerization process depends on solution parameters such as Ph. Thus, polymerization might be induced at one pH and suppressed or reversed at another. Combinations of molecules of appropriate specificities could assemble into structures of predetermined three dimensional forms and properties. These features suggest that Bence Jones proteins represent a powerful model system within which to develop empirical rules relevant to a technology of protein based 'construction.' Development of these rules will require the combined efforts of biophysical and crystallographic studies, protein engineering, and molecular modeling. DOE

N92-18194 Department of the Navy, Washington, DC.
ENERGY BEAM TREATMENT FOR IMPROVED ADHESION OF COATINGS TO SURFACES Patent
Irwin L. Singer, inventor (to Navy) 3 Sep. 1991 15 p Filed 31 Oct. 1989 Supersedes N90-21190 (28 - 14, p 1954), AD-D014449
(AD-D015147; US-Patent-5,045,345; US-Patent-Appl-SN-429959) Avail: US Patent and Trademark Office CSCL 11/3

The coating of a substrate with a coating different from and non-reactive with the substrate is improved by energetic surface alloying of the substrate prior to coating. The ion implantation alters the stoichiometry of the substrate, creating a substrate surface which is reactive with the coating. For example, the bonding of titanium nitrate to silicon nitrides is enhanced by implanting the substrate surface with Ti. GRA

N92-18195 Department of the Navy, Washington, DC.
METAL PHTHALOCYANINES AS CATALYSTS FOR CURING PHTHALONITRILE PREPOLYMERS Patent
Theodore R. Walton, inventor (to Navy) 24 Sep. 1991 5 p Filed 31 May 1990 AD-D014870
(AD-D015151; US-Patent-5,051,493; US-Patent-Appl-SN-531423; US-Patent-Class-528-362) Avail: US Patent and Trademark Office CSCL 07/6

Bisphthalonitrile resins are cured using ionic metal phthalocyanine accelerators. The ionic metal phthalocyanines are nontoxic and accelerate the cure rate of the resins without adversely affecting cured polymer strength. Accordingly, it is an object of this invention to accelerate the polymerization of bisphthalonitrile prepolymers. It is another object of this invention to accelerate the polymerization of bis-phthalonitrile prepolymers without adversely affecting the strength of the cured polymer product. It is a further object of this invention to accelerate the polymerization of bis-phthalonitrile prepolymers with nontoxic catalysts. It is yet another object of this invention to uniformly cure bis-phthalonitrile prepolymers at an accelerated rate. These and additional objects of the invention are accomplished by the use of ionic metal phthalocyanines as accelerators in the curing of bis-phthalonitrile prepolymers. GRA

N92-18210# EG and G Mound Applied Technologies, Miamisburg, OH.
QUANTITATIVE POWDER X RAY DIFFRACTION ANALYSIS OF THE Li2O-SiO2 GLASS-CERAMIC SYSTEM
D. W. Tomlin, D. B. Sullenger, and J. S. Cantrel (Miami Univ., FL.) 28 Oct. 1991 37 p
(Contract DE-AC04-88DP-43495)
(DE92-004777; MLM-3709) Avail: NTIS HC/MF A03

An improved quantitative analysis that uses powder x-ray diffraction has been developed to determine the relative amounts of crystalline phases in samples of Li2-SiO2 glass-ceramics. Existing methods were improved and extended, resulting in a means for estimating a sample's amorphous-to-crystalline content ratio. The quantitative polycrystalline and semi-quantitative amorphous results of this study are currently usable by the Materials Analysis Section at EG&G Mound Applied Technologies. A quality control procedure will be adapted and formulated from the methods developed in this study. DOE

N92-18302# Case Western Reserve Univ., Cleveland, OH. Dept. of Macromolecular Science.
MOLECULAR ENGINEERING OF LIQUID-CRYSTALLINE POLYMERS BY LIVING POLYMERIZATION. PART 18: SC* MESOPHASE IN COPOLYMERS OF (2S, 3S)-(+)-2-CHLORO-3-METHYLPENTYL 4'-(OMEGA-VINYLOXYALKYLOXY) BIPHENYL-4-CARBOXYLATE WITH UNDECANYL AND OCTYL ALKYL GROUPS
Virgil Percec and Qiang Zheng 20 Nov. 1991 36 p Submitted for publication
(Contract N00014-90-J-1828)
(AD-A243366; TR-56) Avail: NTIS HC/MF A03 CSCL 06/1

The synthesis and living cationic polymerization of (2S, 3S)-(+)-2 chloro-3 methylpentyl 4' (11-vinyloxundecanylox)biphenyl 4 carboxylate (15-11) and (2S, 3S)-(+)-2-chloro-3-methylpentyl 4' (8-vinyloxyoctyloxy) biphenyl-4-carboxylate (15-8) are described. Poly(15-11)s and poly(15-8)s with degrees of polymerization (DP) up to 25 and polydispersities lower than 1.15 were synthesized and characterized by differential scanning calorimetry (DSC) and thermal optical polarized microscopy. Over the entire range of molecular weights poly(15-11)s and poly(15-8)s exhibit enantiotropic smectic A (sA) and chiral smectic C (sC) mesophases. In addition, all poly(15-11)s exhibit a crystalline phase. Poly(15-8)s are noncrystallizable. However, poly(15-8)s with degrees of polymerization higher than 12 exhibit an unidentified sX mesophase. Poly(15-11-co-15-8)X/Y, where X/Y represents the molar ratio of monomer 15-11 to monomer 15-8 with DP of about 15 and polydispersities lower than 1.11, was also synthesized and characterized. GRA

N92-18310 Department of the Navy, Washington, DC.
PROCESS FOR PRODUCING UNIFORM PROTECTIVE COATING OF SILVER METAL ON CARBON/CARBON COMPOSITES Patent
Amarnath P. Divecha, inventor (to Navy), William A. Ferrando, inventor (to Navy), Philip W. Hesse, inventor (to Navy), and Subhash D. Karmarkar, inventor (to Navy) 24 Sep. 1991 4 p Filed 3 Jul. 1990
(AD-D015158; US-Patent-5,051,307; US-Patent-Appl-SN-548332)
Avail: US Patent and Trademark Office CSCL 11/3

This patent discloses a process for producing high temperature, oxidation resistant silver metal coatings for carbon/carbon composite structures. The first step of the process involves coating the carbon/carbon surfaces with molten silver nitrate at a temperature above the melting point of AgNO3 but below the decomposition temperature of AgNO3. Next, the resulting uniform coating of molten AgNO3 is heated at a temperature of about 700 C, to decompose the molten AgNO3 and form a uniform coating of silver metal. GRA

N92-18388# Lawrence Livermore National Lab., CA.
DEVELOPMENT OF LOW DENSITY SILICA AEROGEL AS A CAPTURE MEDIUM FOR HYPER-VELOCITY PARTICLES
L. W. Hrubesh and J. F. Poco Oct. 1991 8 p
(Contract W-7405-eng-48)
(DE92-003971; UCRL-CR-105858-91-Summ) Avail: NTIS HC/MF A02

We have developed a method of bonding silica aerogel to various substrate materials including aluminum, silicon, glass, and other aerogels, using a silicon compound. The bonds are stronger than the aerogel, they are transparent, and they have very low off-gassing. We have also improved the transparency of silica aerogels by modifying the sol-gel chemistry that results in the gel. The new aerogels have about 15 percent higher transmission through the visible and 85 percent higher transmission between 250 and 330 nm wavelengths, as compared with conventional silica aerogels. The ultraviolet cut-off wavelength of the aerogel can be varied as desired with our developed method. DOE

N92-18428 Department of the Navy, Washington, DC.
HIGH POLYMER SUSPENSION Patent
Alexander B. Arranaga, inventor (to Navy) 3 Sep. 1991 8 p Filed 7 Nov. 1974
(AD-D015109; US-Patent-5,045,588; US-Patent-Appl-SN-523104; US-Patent-Class-524-445) Avail: US Patent and Trademark Office CSCL 07/6

A high polymer suspension including a polymer, a liquid carrier, a fibrous silicate material, and an organic derivative of clay was mixed. The polymer is preferably a polyacrylamide, the fibrous silicate material a chrysotile asbestos, and the organic derivative of clay, dimethyl benzloctadecyl ammonium hectorite. The invention is a high polymer suspension which includes a polymer such as a polyacrylamide; a liquid carrier, a fibrous silicate material, such as chrysotile asbestos; and an organic derivative of clay, such as dimethylbenzyloctadecyl ammonium hectorite. The present invention is very stable, inexpensive, and retains a high percentage of polymer in suspension. The combination of the chrysotile asbestos and Bentone 27 results in a synergistic effect which gives the invention its high suspending capability, in the order of 30 to 50 pct. of polymer by weight. The present invention may have use in fire fighting applications for producing an extremely long stream of water or for reducing pumping requirements. GRA

N92-18430 Department of the Navy, Washington, DC.
GLASSY BINDER SYSTEM FOR CERAMIC SUBSTRATES, THICK FILMS, AND THE LIKE Patent
Douglas M. Mattox, inventor (to Navy) 27 Aug. 1991 5 p Filed 25 Mar. 1988
(AD-D015111; US-Patent-5,043,302; US-Patent-Appl-SN-172838)
Avail: US Patent and Trademark Office CSCL 11/2

This patent discloses a ceramic material for electronic circuit devices that is sintered at less than or equal to 1000 C. A filler material such as quartz and a glassy binder RO (aluminum oxides) are mixed together along with an appropriate glassy binder prior to firing. RO is drawn from the group of metal oxides, magnesium oxide, calcium oxide, strontium oxide, barium oxide, zinc oxide or cadmium oxide and the glassy binders form no more than 40 pct. vol of the ceramic material. The glassy binder has a suitable viscosity and other properties so that after it is mixed with the quartz filler, sintering occurs at the relatively low temperature. As a consequence, high conductivity conductors made of copper, silver and gold can be appropriately metallized prior to firing. The strength and low dielectric constant of the ceramic material make the material well adapted for ceramic substrates, thick films and the like which are used in VHSIC and VLSI applications. GRA

N92-18445# Midwest Research Inst., Golden, CO. National Renewable Energy Lab.
POLYMERIZABLE 2(2-HYDROXYNAPHTHYL) 2H-BENZOTRIAZOLE COMPOUNDS Patent Application
P. M. Gomez, inventor (to DOE) and H. H. Neidlinger, inventor (to DOE) 21 May 1990 16 p
(Contract DE-AC02-83CH-10093)
(DE92-004618; US-Patent-Appl-SN-525572; Patents-US-A7525572) Avail: NTIS HC/MF A03

It is an object of the invention to provide benzotriazole compounds as a basis for novel polymeric ultraviolet absorbers having higher wavelength cutoffs of up to about 430nm. Particular ultraviolet absorbers are 2(2-Hydroxynaphthyl) 2H-Benzotriazole compounds having polymerizable unsaturated groups attached to the naphthyl double ring. A further object of the invention is to provide 2(2-Hydroxynaphthyl) 2H-Benzotriazole compounds having polymerizable unsaturated groups on the napthyl ring which can be homopolymerized or copolymerized with a comonomer to obtain polymeric ultraviolet absorbers having high wavelength cutoffs of up to about 430nm. DOE

N92-18477# Technische Univ., Eindhoven (Netherlands).
ORIENTED STRUCTURES BASED ON FLEXIBLE POLYMERS: DRAWING BEHAVIOUR AND PROPERTIES Ph.D. Thesis
Cornelis Wilhelmus M Bastiaansen 1991 149 p Sponsored by DSM Research Original contains color illustrations
(ETN-92-90576) Avail: NTIS HC/MF A07

Investigations in the processing, drawing behavior, and properties of solution spun semicrystalline flexible polymers are discussed. The drawing behavior of some semicrystalline polymers is discussed and a scaling law for the maximum attainable draw ratio of linear polyethylenes is derived from experimental data. Results of attempts to further identify the physical nature of the constraints which limit their maximum attainable draw ratio are discussed in relation to solvent-free routes for the production of high modulus and strength structures. The drawing behavior and properties of poly(vinylacohol) is discussed. Compared to linear polyethylenes, additional intermolecular interactions, in the form of hydrogen bonds, are present which reduce their drawability. The drawing behavior of trans-1,4 polybutadiene is investigated and the limits of the properties of drawn flexible polymers are explored. The orientation mechanism of dichroic dyes in drawn polyethylenes is presented. It is shown that high quality polarizers can be produced from dye containing uniaxially drawn, polyethylene films. Solution cast UHMW-PE is shown to be usable as a carrier for large quantities of solid particles, and biaxially drawn UHMW-PE films containing ceramic particles appear to be excellent precursors for (thin) ceramic films. ESA

N92-18478# Technische Univ., Eindhoven (Netherlands).
PREPARATION AND CHARACTERIZATION OF ALPHA'-SIALON CERAMICS Ph.D. Thesis
Guo-Zhong Cao 1991 156 p
(ETN-92-90577) Avail: NTIS HC/MF A08

Investigations into the interrelationships among the chemical compositions, powder characteristics, sintering parameters, microstructure and properties of yttrium-alpha'-sialon ceramics, and the achievement of fully dense alpha'-sialon ceramics using optimized gas pressure sintering parameters are reported.

Composite alpha'+beta'-sialon ceramics are included. Gas pressure sintering was used to achieve full densification of alpha'-sialon ceramics with a fine grained microstructure and the process was optimized by statistical evaluation. Microstructure analysis using X ray diffraction, neutron powder diffraction, optical microscopy, scanning electron microscopy, and transmission electron microscopy are presented. The evaluation of both mechanical properties, such as Vickers hardness, fracture toughness, biaxial bending strength and wear resistance, and oxidation resistance of alpha'-sialon ceramics at various oxidation conditions are reported. Results observed indicate that the increasing amount of oxide additives leads to some negative effects in the microstructure and consequently in the properties of the final products. The composite alpha'+ beta'-sialons has very promising mechanical properties and an oxidation resistance comparable with both monolithic alpha' and beta'-sialon ceramics. ESA

N92-18479# Technische Univ., Eindhoven (Netherlands).
A NOVEL ROUTE TO BLENDS OF POLYSTYRENE AND POLY(2,6-DIMETHYL-1,4-PHENYLENE ETHER): SYNTHESIS, PROPERTIES, AND APPLICATIONS Ph.D. Thesis
Laurentius Nicolaas Nelissen 1991 158 p Sponsored by Bredase Polystyreen Maatschappij B.V.
(ETN-92-90578) Avail: NTIS HC/MF A08

A method for preparing the chemical blend Polystyrene (PS)/Poly(2,6-dimethyl-1,4-Phenylene Ether) (PPE) is described. For the preparation of polymer beads via a free radical initiated suspension polymerization, PPE has to be endcapped in order to avoid the inhibiting effect on the styrene polymerization. A 'cold' endcapping method, to modify PPE under mild conditions in styrene without further purification and isolation of PPE, is presented. Related modification reactions of PPE using various end groups, which can be used for purposes such as (block) copolymerization, are described. Several low polar mass model compounds were synthesized to gain a better understanding of the inhibiting effect from the terminal 2,6-xylenol group of PPE. The phase behavior of the miscible PS/PPE blend was studied as a function of pressure. Compression or injection molding of the blend results in a two phase and multiple phase separated blend respectively. As a consequence of the phase separation phenomenon under pressure, conventional processing of PS/PPE-Ac blends is not feasible. The application of the system for preparing high Tg PS foams is described. ESA

N92-18480# Technische Univ., Eindhoven (Netherlands).
TOWARDS THE COMPUTATION OF PROPERTIES OF INJECTION MOULDED PRODUCTS: FLOW- AND THERMALLY INDUCED STRESSES IN AMORPHOUS THERMOPLASTICS Ph.D. Thesis
Lucien Ferdinand Ann Douven 1991 176 p Sponsored by the Ministerie van Economische Zaken
(ISBN-90-9004243-1; ETN-92-90579) Avail: NTIS HC/MF A09

A decoupled method to calculate flow-induced stresses is proposed. The kinematics of the flow field are determined using a viscous, generalized Newtonian constitutive law for the Cauchy stress tensor in combination with the balance laws, for all stages of the process. Transient stresses are calculated by substitution of the flow kinematics in a viscoelastic constitutive equation. Thermally induced stresses, calculated by using the viscoelastic constitutive models, used compressible versions of the Leonov model (differential formulation) and of the K-BKZ model (integral formulation). Special attention is paid to the boundary conditions for realistic results. In particular, it is shown that not only the temperature history but also the pressure history has a marked influence on the residual stress state of an injection molded product. A fair prediction of the properties of injection molded products is obtained. The conclusion is that for more precise predictions, future attention should be focused on a more accurate and extended determination of the material properties. In particular, nonequilibrium pvT-data (the pvT-relation being an implicit form of a constitutive relation for the hydrostatic part of the Cauchy stress sensor), the pressure dependence of the stationary shear viscosity, and the shear rate dependent first normal stress difference should be measured with great accuracy. ESA

N92-18511# EG and G Mound Applied Technologies, Miamisburg, OH.
LOW TEMPERATURE PROPERTIES OF ENGINEERING THERMOPLASTICS
C. J. Kaye 1991 11 p Presented at the 23rd International Technical Conference of the Society for the Advancement of Materials and Process Engineering, New York, NY, 22-24 Oct. 1991
(Contract DE-AC04-88DP-43495)
(DE92-004009; MLM-3720(OP); CONF-911023-1) Avail: NTIS HC/MF A03

There are currently a wide variety of engineering thermoplastics available for a multitude of applications. Because of present market requirements, there has been a limited demand for test results of the physical properties of these materials at low temperatures. Several potential applications exist, however, and as a result, several engineering thermoplastic samples were tested at -40 and -56.6 C. Although not all these tests followed the procedures specified by the American Society of Testing and Materials precisely, the data represent comparative data that can be utilized for further design efforts. The evaluations included tensile testing, compressive properties, and Izod impact testing. Several materials with varied glass loadings were studied to determine the low temperature tendencies these molding compounds would exhibit. Some of the resins examined were: polyetheretherketone (PEEK), polyetherimide (PEI), polyphenylene sulfide (PPS), polyethersulfone (PES), polyphthlamide (PPA), and a liquid crystal polymer (Vectra A130). In all cases, no detrimental effect was discerned over this temperature range; the study also indicated that improvements in the physical properties could be expected. DOE

N92-18512# Texas Univ., Austin. Dept. of Chemical Engineering.
SYNTHESIS AND ANALYSIS OF NOVEL POLYMERS WITH HIGH PERMSELECTIVITY AND PERMEABILITY IN GAS SEPARATION APPLICATIONS
W. J. Koros and D. R. Paul 15 Nov. 1991 15 p
(Contract DE-FG05-86ER-13507)
(DE92-004057; DOE/ER-13507/7) Avail: NTIS HC/MF A03

We have synthesized and completed characterization of permeability and selectivity properties of a group of polysulfones and polyether ketones with the potential for higher use temperatures, as well as members of a series of polyesters derived from spirobiindane bisphenol monomer in conjunction with meta and para substituted diacid chlorides. We have also synthesized and characterized the gas transport and thermal properties of diphenyl substituted polyphenylene oxide. The diphenyl substituted material has a potential for higher temperature applications than the standard dimethyl substituted polymer. The temperature dependence of the gas transport properties for the oxygen/nitrogen system was characterized over the range from 35 to 65 C for both of these analog materials. DOE

N92-18563# Oak Ridge National Lab., TN.
MICROWAVE SINTERED SILICON NITRIDE CERAMICS
T. N. Tiegs, J. O. Kiggans, and P. A. Menchhofer 1991 6 p Presented at the 2nd Conference of the European Ceramic Society, Augsburg, Fed. Republic of Germany, 11-14 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004405; CONF-910908-2) Avail: NTIS HC/MF A02

Silicon nitride-based materials are processed using a variety of thermal heating techniques and procedures, such as sintering, reaction-bonding, and annealing. For sintering, typical silicon nitride processing starts with high (alpha)-phase Si_3N_4 powders mixed with sintering aids, such as MgO, Y_2O_3, and Al_2O_3. After consolidation of the mixtures into a shape, they are heated in a nitrogen atmosphere to temperatures of 1700 to 1900 C to densify. The sintering temperature is dependent on the type and quantity of sintering additives utilized. Densification of silicon nitride

compacts occurs through a number of distinct steps. Microwave heating has the capability for volumetric thermal heating of ceramic materials. Silicon nitride-based materials heat in a microwave field by coupling to the sintering additives or grain boundary phases. Previous studies on microwave processing of silicon nitride have reported improved densification during sintering, accelerated nitridation of silicon, and improved high temperature mechanical properties with thermal annealing of dense materials. In the present research, microwave-sintered silicon nitride ceramics were examined, and the densification behavior and microstructure development correlated with the mechanical properties. DOE

N92-18716# Lawrence Livermore National Lab., CA.
LOW-DENSITY CARBONIZED RESORCINOL-FORMALDEHYDE FOAMS
F. M. Kong, S. R. Buckley, C. L. Giles, Jr., B. L. Haendler, L. M. Hair, S. A. Letts, G. E. Overturf, III, C. W. Price, and R. C. Cook Jul. 1991 58 p
(Contract W-7405-eng-48)
(DE92-004848; UCRL-LR-106946) Avail: NTIS HC/MF A04

This report documents research and development on resorcinol-formaldehyde-based foam materials conducted between 1986 and June 1990, when the effort was discontinued. The foams discussed are resorcinol-formaldehyde (RF) foam, carbonized RF (CRF) foam, and two composite foams, a polystyrene/RF (PS/RF) foam and its carbonized derivative (CPR). The RF foams are synthesized by the polycondensation of resorcinol with formaldehyde in a slightly basic solution. Their structure and density depend strongly on the concentration of the sodium carbonate catalyst. The have an interconnected bead structure similar to that of silica aerogels; bead sizes range from 30 to 130 A, and cell sizes are less than 0.1 microns. We have achieved densities of 16 to 200 mg/cc. The RF foams can be pyrolyzed in an inert atmosphere to form a vitreous carbon foam (CRF), which has a similar microstructure but much higher mechanical strength. The PS/RF foams are obtained by filling the 2- to 3-micron cells of PS foam (a low-density hydrocarbon foam we have developed) with RF. The resultant foams have the outstanding handling and machinability of the PS foam matrix and the small cell size of RF. Pyrolyzing PS/RF foams causes depolymerization and loss of the PS; the resulting CPR foams have a structure similar to the PS foams in which CRF both replicates and fills the PS cells. DOE

N92-18727# Northwestern Univ., Evanston, IL.
MIXED-IONIC AND ELECTRONIC CONDUCTIVITY IN POLYMERS
M. A. Ratner and D. F. Shriver 1991 4 p
(Contract DE-FG02-85ER-45220)
(DE92-005076; DOE/ER-45220/8) Avail: NTIS HC/MF A01

The aim in this portion of the research is to prepare new electroactive films with high ion mobility and to characterize the transport properties of these materials. The classic conducting polymers, polyacetylene, polythiophene, and polypyrrole have dense structures that prevent rapid redox switching because of the low diffusivity of ions. The objective is to modify the last two polymers with pendant polyethers, which should greatly improve ion transport. DOE

N92-18733# Queens Coll., Flushing, NY. Dept. of Physics.
SURFACE AND INTERFACIAL PROPERTIES OF POLYMER BLENDS
M. Rafailovich and J. Sokolov Nov. 1991 8 p
(Contract DE-FG02-90ER-45437)
(DE92-004074; DOE/ER-45437/1) Avail: NTIS HC/MF A02

This is a summary of the research we have conducted since receiving our DOE grant and research plans for the coming year. As you will notice, most of the research objectives of our original proposal were met, especially in regard to measuring surface segregation and interface formation in polymer blends. Our program has therefore expanded into other directions such as the study of the surface visco-elastic properties of polymer liquids and solutions, the conformations of polymer chains grafted onto silica surfaces, and the dynamics of cross linked polymer networks. DOE

N92-18749# Brookhaven National Lab., Upton, NY.
DETERMINATION OF POLYMERIZATION PARTICLE MORPHOLOGY USING SYNCHROTRON COMPUTED MICROTOMOGRAPHY
K. W. Jones, P. Spanne, W. B. Lindquist, W. C. Conner, and M. Ferrero Oct. 1991 18 p Presented at the 2nd European Conference on Accelerators in Applied Research and Technology, Frankfurt am Main, Fed. Republic of Germany, 3-7 Sep. 1991
(Contracts DE-AC02-76CH-00016; DE-FG02-90ER-25084)
(DE92-004992; BNL-46226; CONF-910921-1) Avail: NTIS HC/MF A03

Polymerization of monomers over heterogeneous catalysts results in the fragmentation of the catalysts and subsequent transport in the polymer particles that are produced. Characterization of the process using nondestructive synchrotron computed microtomography techniques makes possible measurement of the distribution of the catalyst fragments in an individual particle and, in addition, gives an estimate of the particle porosity and surface area. The present experiment was carried out using the x-ray microscopy facility at the Brookhaven National Synchrotron Light Source (NSLS) X26 beam line. The tomographic sections were analyzed using autocorrelation techniques to determine porosity and surface area values. The results are compared to values obtained using conventional methods. This procedure makes possible the extraction of quantitative information about porosity and specific area from the tomograms. DOE

N92-18812# Texas Univ., Arlington. Center for Advanced Polymer Research.
POLY(1,3-CYCLOHEXADIENE-ALT ALPHA-FLUOROACRYLONITRILE): SYNTHESIS AND STRUCTURAL ANALYSIS OF A NEW ALTERNATING COPOLYMER Technical Report, 1 Jun. - 30 Sep. 1991
V. Panchalingam and John R. Reynolds 21 Oct. 1991 26 p
(Contract N00014-90-J-1320)
(AD-A242257; TR-34) Avail: NTIS HC/MF A03 CSCL 07/6

Poly (1,3 cyclohexadiene-alt-alpha fluoroacrylonitrile) poly(1,3-CHD/alpha-FAN), an alternating copolymer of alpha-fluoroacrylonitrile and 1,3-cyclohexadiene has been prepared in bulk using varying monomer feed ratios and AIBN as initiator at 65 C. Elemental and 1H-NMR analyses indicate that the copolymer contains an equimolar composition of alpha-FAN and 1,3-CHD as observed for alternating copolymers with donor-acceptor polymerizations. A 2-D H-COSY NMR experiment indicates that the copolymer contains 1,4-linkages across the cyclohexene unit while more reliable C-NMR spectra suggests the copolymer to contain both 1,2- and 1,4-linkages. Poly(1,3 CHD/alpha-FAN) exhibits improved thermal stability relative to the alternating copolymer of 1,3-CHD and alpha-chloroacrylonitrile due to a higher resistance to HF elimination relative to HCl elimination. GRA

N92-18827# Cornell Univ., Ithaca, NY. School of Chemical Engineering.
POLYMER RESIST SYSTEMS FOR ADVANCED MICROLITHOGRAPHY Final Report, 1 Jun. 1985 - 31 Dec. 1991
F. Rodriguez and S. K. Obendorf 31 Dec. 1991 7 p
(Contract N00014-85-K-0474)
(AD-A244329) Avail: NTIS HC/MF A02 CSCL 11/3

The aim throughout this work has been to produce and characterize resist systems with enhanced sensitivity, resolution, and etch resistance. New polymers and polymer systems were evaluated as e-beam and x-ray resists using gamma radiation, flood exposure to electrons, synchrotron radiation, and e-beam patterning. The systems investigated have included copolymers and blends. In particular, reactive plasticizers were found to impart high sensitivity to negative-working resists with good resolution. Because of the overwhelming importance of the development step in producing high resolution patterns, dissolution rate measurements were refined and applied to a number of problems. As far as resistance to ion-assisted plasma etching is concerned, our studies have established the importance of conditions including flow rates, power density, pressure, etc. GRA

N92-18847# Ames Lab., IA.
THEORETICAL STUDIES OF AMORPHOUS SILICON AND HYDROGENATED AMORPHOUS SILICON WITH MOLECULAR DYNAMICS SIMULATIONS Ph.D. Thesis
I. Kwon 20 Dec. 1991 102 p
(Contract W-7405-eng-82)
(DE92-005093; IS-T-1587) Avail: NTIS HC/MF A06

Amorphous silicon (a-Si) and hydrogenated amorphous silicon (a-Si:H) have been studied with molecular dynamics simulations. The structural, vibrational, and electronic properties of these materials have been studied with computer generated structural models and compare well with experimental observations. The stability of a-si and a-Si:H have been studied with the aim of understanding microscopic mechanisms underlying light-induced degradation in a-Si:H (the Staebler-Wronski effect). With a view to understanding thin film growth processes, a-Si films have been generated with molecular dynamics simulations by simulating the deposition of Si-clusters on a Si(111) substrate. A new two- and three-body interatomic potential for Si-H interactions has been developed. The structural properties of a-Si:H networks are in good agreement with experimental measurements. The presence of H atoms reduces strain and disorder relative to networks without H. DOE

N92-18873# Stanford Univ., CA. Dept. of Materials Science and Engineering.
SUPERPLASTIC CERAMICS (WITH EMPHASIS ON IRON CARBIDE) Final Report, 1 May 1988 - 30 Apr. 1991
Oleg D. Sherby, Jeffrey Wolfenstine, and Woo-Jin Kim 31 Jul. 1991 6 p
(Contract DAAL03-88-K-0056)
(AD-A244391; ARO-25432.1-MS) Avail: NTIS HC/MF A02
CSCL 11/2

This final report summarizes work accomplished on superplastic ceramics with special emphasis on developing processing methods for creating ultra-fine structures in iron carbide, quantifying its microstructure and assessing its superplastic characteristics. The two principal objectives of this program are (1) to develop processing methods for achieving stable ultrafine grained (in the order of one micron) carbide-base materials, and (2) to evaluate and understand the mechanical behavior of ultrafine grained carbides at high temperatures, with special attention to superplastic flow and failure mechanisms. GRA

N92-18907# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Lab. Associado de Sensores e Materiais.
ON THE USE OF PHOTOTHERMAL DETECTION TECHNIQUES TO THE THERMAL DIFFUSITY MEASUREMENTS
N. F. Leite and L. C. M. Miranda Jun. 1991 8 p Presented at the 3rd Brazilian Thermal Science Meeting, Itapema, Brazil, 10-12 Dec. 1990
(INPE-5261-PRE/1685) Avail: NTIS HC/MF A02

In this paper, we report on the photothermal measurements of the thermal diffusivity of two-layer systems and of polymer polyvinylidene fluoride (PVDF) films subjected to different poling fields. The thermal diffusivity was measured using the so-called open photoacoustic cell (OPC) method in which the photoacoustic (PA) signal is investigated as a function of the modulation frequency in a heat transmission configuration. Author

N92-18908# Pennsylvania State Univ., University Park. Dept. of Chemistry.
THE SYNTHESIS AND STRUCTURE OF POLYPHOSPHAZENES Final Report, 15 Jun. 1988 - 24 Jun. 1991
Harry R. Allcock 18 Jul. 1991 7 p
(Contract DAAL03-88-K-0112)
(AD-A244415; ARO-25280.25-CH) Avail: NTIS HC/MF A02
CSCL 07/6

This project has involved the design of new inorganic organic organometallic polymers and the development of new methodologies that allow their synthesis. The new polymers have properties that range from elastomers or membranes to glasses and electroactive materials, and are expected to be useful in a range of applications that require low-temperature flexibility, resistance to hydrocarbons, oxidation resistance, and sensor behavior. GRA

N92-18954# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
LITHOGRAPHIC MICROPATTERNING OF POLYTHIOPHENE THIN-FILMS M.S. Thesis
Carl A. Kutsche Dec. 1991 92 p
(AD-A243819; AFIT/GE/ENG/91D-32) Avail: NTIS HC/MF A05
CSCL 14/5

Several semiconductor processing procedures that could be used to micropattern polythiophene thin-films were investigated. Using standard semiconductor lithographic processing procedures as a guide to what environments the polythiophene would be exposed to, a series of tests duplicating specific processing steps were devised. These tests determined that polythiophene could withstand heating on a hot plate to 150 C for 5 minutes, heating in a convection oven to 200 C for 30 minutes, and to 100 C for 1 hour without changing thin film thickness, index of refraction, surface morphology, or absorbance. Of the solvents polythiophene was exposed to, only isopropyl alcohol caused no film deformation. A reactive ion etching process using a low temperature silicate passivating and masking layer over the polythiophene is recommended for processing polythiophene. Using this procedure highly anisotropic structures were achieved using a 5 minute reactive ion etch with a chamber pressure of 50 mtorr, plasma power of 100 watts, and an oxygen flow rate of 50 standard cubic centimeters per minute. GRA

28 PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion.*

N92-18176# Los Alamos National Lab., NM.
VACUUM THERMAL STABILITY OF EXPLOSIVES MONITORED ELECTRONICALLY
J. F. Baytos Nov. 1991 20 p
(Contract W-7405-eng-36)
(DE92-003735; LA-12173-MS) Avail: NTIS HC/MF A03

Two innovations make the vacuum thermal stability (VTS) of explosives amenable to electronic monitoring. The first innovation is that the manometer tube is incorporated as a capacitance transducer into a circuit that generates a voltage proportional to the height of the manometer column. The second innovation is an air back-pressure system by which an air-pressure reduction valve is used to adjust the height of the mercury column so that voltage can be calibrated as a function of the height of the mercury column with the manometer in place. Addition of a power supply/demodulator unit, a data acquisition/control unit, and a dedicated computer complete the monitoring system. A complete description of Los Alamos National Group M-1's modular VTS system is reported, including the heating bath, temperature controller, pressure system, and electronics for data acquisition. Errors of the system are discussed, and typical results for some explosives are given. The calibration, operating, and reporting procedures are given in the Appendices. DOE

N92-18246# Materials Research Labs., Ascot Vale (Australia).
CONVERSION OF PROPELLANT GRADE PICRITE TO SPHERICAL NITROGUANIDINE
Robert J. Spear, Lance D. Redman, and Russell Barrow (Melbourne Univ., Parkville, Australia) Sep. 1991 43 p
(MRL-TR-91-33; AR-006-826) Avail: NTIS HC/MF A03

The preparation of spherical nitroguanidine (SNQ) from Australian propellant grade picrite (NQ) was studied. A method based on N-methylpyrrolidone (NMP) and acetone as solvent/nonsolvent was found to give a good quality SNQ product

from a variety of picrite batches. Larger spheres can be grown under these conditions by controlled seeding. Attempts to use recycled NMP and acetone gave an unsatisfactory product in general. Use of aqueous based systems gave a poor product. Particle size, bulk density, and hazard properties are determined for a number of batches. Recommendations on future research to evaluate SNQ formulations as insensitive main charge explosives are outlined. Author

N92-18261# Sandia National Labs., Albuquerque, NM.
EXPLOSIVE VAPOR EMISSION
B. T. Kenna, F. J. Conrad, and D. W. Hannum 1991 11 p Presented at the FAA Explosives Detection Symposium, Atlantic City, NJ, 13-15 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-002932; SAND-91-2486C; CONF-9111129-1) Avail: NTIS HC/MF A03

Emission rates of explosive vapors from explosive samples dictate whether various techniques can be used to provide a constant vapor source for instrument evaluation. Indeed, emission rates determine whether a particular detection system is applicable directly for explosive vapor detection or if an initial 'helping' step, such as preconcentration, is required. This work is a theoretical study of emission rate for TNT and RDX. Two vapor source techniques are evaluated, using a wire mesh screen coated with explosive material in a 'hair dryer' air flow and a packed column of various lengths which has air flow through it. DOE

N92-18264*# Alabama Univ., Huntsville. Quality Engineering Research Lab.
PROPELLANT VARIABILITY ASSESSMENT Final Report
Thomas P. Tytula and Kristin Schad Dec. 1991 8 p
(Contract NAS8-36955)
(NASA-CR-184283; NAS 1.26:184283; UAH-QERL-91-3) Avail: NTIS HC/MF A02 CSCL 21I

Efforts to determine whether rocket propellant density and modulus can be reliably measured using non-destructive ultrasonic techniques are reported. The objective was not achieved, primarily due to the approach taken. Author

N92-18311 Department of the Navy, Washington, DC.
PLASTIC BONDED EXPLOSIVES USING FLUOROCARBON BINDERS Patent
May L. Chan, inventor (to Navy), Russell Reed, Jr., inventor (to Navy), Herb G. Gollmar, inventor (to Navy), Carl Gotzmer, inventor (to Navy), and Robert C. Gill, inventor (to Navy) 17 Sep. 1991 4 p Filed 10 Oct. 1985
(AD-D015166; US-Patent-5,049,213; US-Patent-Appl-SN-791548; US-Patent-Class-149-19.3) Avail: US Patent and Trademark Office CSCL 19/1

A high energy, thermally stable plastic bonded explosive is disclosed. An object of this invention is to make use of a fluorocarbon binder. Additionally, this invention, the plastic bonded explosive, is characterized as deformable. The plastic bonded explosive (PBX) is comprised of a solid explosive filter, a plasticizer, and an acrylate or urethane fluorocarbon binder. This invention utilizes cyclo tetramethylene tetranitramine (HMX) or cyclo trimethylene trinitramine (RDX) as the explosive filter. GRA

N92-18343# Materials Research Labs., Ascot Vale (Australia).
APPLICATION OF THE CPEX NON-IDEAL EXPLOSIVE MODEL TO PBXW-115
David A. Jones and David L. Kennedy (Imperial Chemical Industries Ltd., Victoria, Australia) Oct. 1991 30 p
(MRL-TR-91-40; AR-006-833) Avail: NTIS HC/MF A03

A detailed description is presented of the use of the ICI nonideal detonation code CPEX to model the performance of the composite underwater explosive PBXW-115 (20 pct. RDX, 43 pct. AP, 25 pct. Al, and 12 pct. HTPB). Both the ICI chemical equilibrium code IDEX and Mader's BKW code was used to first estimate the Chapman-Jouguet parameters for PBXW-115. Two different reaction rate models are assumed for the decomposition of the explosive components and the time constants for each are found by fitting to experimental US data on the variation of detonation velocity with charge diameter. The data is best fitted by a three term reaction rate model which equates hotspot content to some fraction of RDX content, the intermediate scale reaction primarily to the AP decomposition, and the slowest process to the Al reaction. After adjusting some of the reaction time constants because of differences between the US and Australian compositions, the model then accurately reproduces the variation of detonation velocity with charge diameter found for Australian PBXW-115. Author

N92-18344# Materials Research Labs., Maribyrnong (Australia).
PLASTICIZED ETHYLENE-VINYL ACETATE BINDERS FOR INSENSITIVE BOOSTER COMPOSITIONS
I. J. Dagley, R. P. Parker, L. Montelli, and C. N. Louey Sep. 1991 18 p
(MRL-TR-91-34; AR-006-827) Avail: NTIS HC/MF A03

Plasticizers were incorporated into RDX ethylene vinyl acetate (EVA) compositions prepared by the solvent slurry coating technique. The effect of plasticizers on impact sensitiveness, shock sensitivity, cookoff behavior and integrity of pressed pellets was examined for compositions with EVA binders of varying vinyl acetate content. A compatible EVA/plasticizer combination gave an appreciable reduction in cookoff response and impact sensitiveness. Plasticizer migration is likely to affect the long term stability of these compositions. Author

N92-18442*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
SELF-PRESSURIZATION OF A FLIGHTWEIGHT LIQUID HYDROGEN TANK: EFFECTS OF FILL LEVEL AT LOW WALL HEAT FLUX
N. T. VanDresar, M. M. Hasan, and C.-S. Lin (Analex Corp., Brook Park, OH.) 1991 11 p Presented at the 30th Aerospace Sciences Meeting and Exhibit, Reno, NV, 6-9 Jan. 1992; sponsored by AIAA
(NASA-TM-105411; E-6813; NAS 1.15:105411; AIAA-92-0818)
Avail: NTIS HC/MF A03 CSCL 21I

Experimental results are presented for the self pressurization and thermal stratification of a 4.89 cu m liquid hydrogen storage tank subjected to low heat flux (2.0 and 3.5 W/sq m) in normal gravity. The test tank was representative of future spacecraft tankage, having a low mass to volume ratio and high performance multilayer thermal insulation. Tests were performed at fill levels of 29 and 49 pcts. (by volume) and complement previous tests at 83 pct. fill. As the heat flux increases, the pressure rise rate at each fill level exceeds the homogeneous rate by an increasing ratio. Herein, this ratio did not exceed a value of 2. The slowest pressure rise rate was observed for the 49 pct. fill level at both heat fluxes. This result is attributed to the oblate spheroidal tank geometry which introduces the variables of wetted wall area, liquid-vapor interfacial area, and ratio of side wall to bottom heating as a function of fill level or liquid depth. Initial tank thermal conditions were found to affect the initial pressure rise rate. Quasi steady pressure rise rates are independent of starting conditions. Author

N92-18813# Environmental Protection Agency, Ann Arbor, MI. Office of Mobile Sources.
EVALUATION OF A KEMIRA OY RESISTIVELY HEATED CATALYST ON A METHANOL-FUELED VEHICLE
Gregory K. Piotrowski and Ronald M. Schaefer Sep. 1991 31 p
(PB92-104397; EPA/AA/CTAB-91/04) Avail: NTIS HC/MF A03 CSCL 07D

A fresh resistively heated catalytic converter was furnished by Kemira Oy to the US Environmental Protection Agency (EPA) for evaluation on a methanol-fueled vehicle. This converter substrate was constructed from metallic foil and was considerable smaller in volume than three-way catalysts found on most late model US automobiles. The Kemira Oy converter is referred to hereafter as an electrically heated catalyst (EHC). The EHC was evaluated in four separate modes. First, this catalyst was placed on an M100

(neat methanol) fueled vehicle and emission tested without resistive heating or catalyst air assist. The EHC was then tested using resistive heating, but with no air assist provided during the period of heating. A catalyst operating mode utilizing both resistive heating and air assist was evaluated next. Finally, a larger catalyzed ceramic monolith was added behind the EHC as a main catalyst. This two-catalyst system was then evaluated, with resistive heating and catalyst air assist applied to the upstream EHC. GRA

29 MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications.

For biological materials see *55 Space Biology*.

N92-18201*# Hughes Aircraft Co., Torrance, CA. Electron Dynamics Div.

INVESTIGATION OF MICRO-GRAVITY EFFECTS ON HEAT PIPE THERMAL PERFORMANCE AND WORKING FLUID BEHAVIOR, PHASE B Final Technical Report

K. D. Gier and M. O. Smith Jan. 1990 105 p

(Contract NAS5-30359)

(NASA-CR-189254; NAS 1.26:189254) Avail: NTIS HC/MF A06 CSCL 22A

The purpose of this experiment is to develop an in-depth understanding of the behavior of heat pipes in space. Both fixed conductance heat pipes (FCHPs) with axial grooves and variable conductance heat pipes (VCHPs) with porous wicks will be investigated. This understanding will be applied to the development of improved performance heat pipes subjected to various accelerations in space, including those encountered on a lunar base or Mars mission. More efficient, reliable, and lighter weight spacecraft thermal control systems should result from these investigations. Author

N92-18212# Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Raumfahrttechnik.

NATURAL FREQUENCIES AND AXIAL RESPONSE OF A LIQUID LAYER UNDER THE INFLUENCE OF AN AXIAL STEADY MICRO-GRAVITY FIELD

Helmut F. Bauer and Lothar Kammerer 1990 58 p

(LRT-WE-9-FB-16(1990); ETN-92-90631) Avail: NTIS HC/MF A04

Under the action of a steady axial gravity field, a liquid layer experiences a change of natural frequencies in comparison with the annular layer. The natural frequencies exhibit a decrease with increasing axial bond number and liquid height. This is particularly pronounced in lower modes. The response of the liquid layer to axial excitation is investigated and shows resonance peaks for all modes in contrast to those of the circular cylindrical layer. Increase of axial bond number yields increases in response magnitude. ESA

N92-18247*# Stanford Univ., CA. Center for Materials Research.

PROTEIN CRYSTAL GROWTH IN LOW GRAVITY Semiannual Technical Report, 6 Jun. - 6 Dec. 1991

Robert S. Feigelson Feb. 1992 25 p

(Grant NAG8-774)

(NASA-CR-189883; NAS 1.26:189883; SU-CMR-92-1; SU-SPO-7218) Avail: NTIS HC/MF A03 CSCL 22A

A study is presented of the crystallization of isocitrate lyase (ICL) and the influence of the lack of thermal solutal convection in microgravity on the morphology of ICL crystals is discussed. The latest results of studies with thermonucleation are presented. These include the nucleation of a protein with retrograde solubility and an unknown solubility curve. A new design for a more microgravity compatible thermonuclear is presented. Author

31 ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

N92-18036# National Aerospace Lab., Tokyo (Japan). Space Technology Research Group.

EFFECTIVE CLEANING OF OIL-PROTECTED BEARING STEEL EXAMINED BY XPS ANALYSIS. PART 2: LOW POLLUTION CLEANING

Makoto Nishimura, Masami Minami, and Akihiko Matsui (Mitsubishi Heavy-Industries Ltd., Tokyo, Japan) Apr. 1991 13 p In JAPANESE; ENGLISH summary

(NAL-TR-1104; ISSN-0389-4010) Avail: NTIS HC/MF A03

A cleaning procedure for ball bearings was developed which has a low possibility for environmental pollution. Both a commercially-available synthetic detergent and a potassium fatty acid (27 percent solution) were tested to determine their ability to clean bearing balls protected by an anti-rust oil containing barium sulfonate and zinc sulfonate. Results were compared. An X-ray photoelectron spectroscopy (XPS) analysis was performed to evaluate their effectiveness. Results showed that a synthetic detergent ultrasonic cleaning followed by an ethanol completely cleaned a mirror-finished surface, but not a turned one (Rmax: 20 microns). It was additionally determined that the potassium fatty acid solution exhibited superior cleaning capability when compared with organic solvents, including trichloroethylene, although the potassium fatty acid solution was inferior to the alkaline detergents. Author

N92-18097# EG and G Rocky Flats, Inc., Golden, CO.

PRECISION JOINING CENTER

J. W. Powell and D. A. Westphal Aug. 1991 95 p Presented at the Precision Joining Center Workshop, Breckenridge, CO, 10-12 Jul. 1991

(Contract DE-AC34-90DP-62349)

(DE92-002621; RFP-4511; CONF-9107187-Summ) Avail: NTIS HC/MF A05

A workshop to obtain input from industry on the establishment of the Precision Joining Center (PJC) was held on July 10-12, 1991. The PJC is a center for training Joining Technologists in advanced joining techniques and concepts in order to promote the competitiveness of U.S. industry. The center will be established as part of the DOE Defense Programs Technology Commercialization Initiative, and operated by EG&G Rocky Flats in cooperation with the American Welding Society and the Colorado School of Mines Center for Welding and Joining Research. The overall objectives of the workshop were to validate the need for a Joining Technologists to fill the gap between the welding operator and the welding engineer, and to assure that the PJC will train individuals to satisfy that need. The consensus of the workshop participants was that the Joining Technologist is a necessary position in industry, and is currently used, with some variation, by many companies. It was agreed that the PJC core curriculum, as presented, would produce a Joining Technologist of value to industries that use precision joining techniques. The advantage of the PJC would be to train the Joining Technologist much more quickly and more completely. The proposed emphasis of the PJC curriculum on equipment intensive and hands-on training was judged to be essential. DOE

N92-18187# Department of the Navy, Washington, DC.

AIR CUSHION VEHICLE CONDUCTIVE/SEMICONDUCTIVE FLEXIBLE SKIRT, AND METHOD Patent Application

Richard A. Cavenagh, inventor (to Navy) and Raymond W. Dyke, inventor (to Navy) 2 Mar. 1990 14 p

(AD-D015160; US-Patent-Appl-SN-487489) Avail: NTIS HC/MF A02

Discussed here is a method for dissipating static electrical energy from air cushion vehicles when operating more particularly in cold, low humidity environments, which method involves fabricating the skirt assembly from a flexible sheet material of at least semiconductive character, which will provide a suitable dissipating grounding pathway to discharge potential static electrical

energy generated during the aforesaid operation. The method includes using a coated flexible fabric material having at least one of its opposite surfaces coated with an elastomeric abrasion-resistant material, and embedding a plurality of electrically conductive flexible strands at least partially within said flexible fabric material, or alternatively embedding electrically conductive particles or fibers in a generally uniformly manner throughout a forming of its elastomeric composition. The invention also is directed specifically to/on an air cushion vehicle skirt component comprised of electrically conductive composite flexible sheet material having sufficient conductive characteristics to provide a near constant dissipation grounding pathway from said vehicle for any substantial build up of generated static electrical energy, more particularly when the air cushion vehicle is operating in cold, low humidity environments. GRA

N92-18475# Technische Univ., Eindhoven (Netherlands).
ON THE THERMAL INTERACTION OF BUILDING STRUCTURE AND HEATING AND VENTILATION SYSTEM Ph.D. Thesis
Joannes Laurentius M Hensen 1991 197 p
(ISBN-90-386-0081-X; ETN-92-90574) Copyright Avail: NTIS HC/MF A09

Developments in the field of building performance evaluation tools for thermal interaction of building structure and heating and ventilating systems are described. The technique employed is computer simulation of the integrated dynamic system comprising the occupants, the building and its heating and ventilating system. Assessment criteria from a literature review in thermal comfort to examine acceptable fluctuations in indoor climate are defined. Building and plant energy simulation within the context of Computer Aided Building Design (CABD) is described. An exisiting energy simulation environment ESP(R) (Environmental Systems Performance (Research version)) is chosen. A fluid flow network simulation module is described. Extensions to ESP(R) to predict the dynamic behavior of the heating and ventilation system are described. The coupling of fluid flow, plant side energy and mass, and building side energy simulation into one integrated program is described. A multistage verification and validation methodology is demonstrated by examples addressing each successive step. Imaginary and real world cases are described to demonstrate application of the study in a modeling orientated and a building engineering context. ESA

N92-18607# European Space Agency, Paris (France).
SPACE PRODUCT ASSURANCE FOR EUROPE IN THE 1990S: AN ESA SYMPOSIUM
James J. Hunt, ed. Aug. 1991 289 p In ENGLISH and FRENCH Symposium held in Noordwijk, Netherlands, 15-19 Apr. 1991
(ESA-SP-316; ISBN-92-9092-106-4; ISSN-0379-6566; ETN-92-90460) Copyright Avail: NTIS HC/MF A13

Aspects of space product assurance programs for European space projects are discussed. Product assurance management relating to specifications and requirements is studied. Risk assessment and organizational robustness are discussed. Product assurance software is given special attention. Software dependability assessment and software control of hazards in space missions are discussed. Reliability, availability, maintainability and safety issues are considered. Safety risk management is discussed. Total quality management as a means of product assurance is considered from different perspectives. For individual titles, see N92-18608 through N92-18656.

N92-18608# Eurospace, Paris (France).
INTERNATIONAL COLLABORATION IN PA AND SAFETY, THE EUROSPACE PA-PANEL **c38**
J. Levold (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 5-8 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

The EUROSPACE Product Assurance (PA) Panel, an active body of senior representatives from aerospace industry gathered to interact with the European Space Agency (ESA) on standards and requirements, is described. Comments on Procedures, Specifications, and Standards-01 (PSS-01) requirements, as well as actual implementation in Ariane 5, Columbus, and Hermes, are presented. A tendency towards overspecification and demand for bureaucratic tasks must be avoided, and the international competitiveness of the space industry in non ESA projects enhanced. Recommendations towards this aim and improved collaboration between ESA and industry are made. ESA

N92-18609# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Columbus System and Project Dept.
ESTABLISHMENT AND IMPLEMENTATION OF COMMON PRODUCT ASSURANCE AND SAFETY REQUIREMENTS FOR THE CONTRACTORS OF THE COLUMBUS PROGRAMME
H. Wessels and H. J. Stephan (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 9-16 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

When establishing the Columbus Product Assurance (PA)/safety requirements, the international environment of the Space Station Freedom program has to be taken into account. Considerations given to multiple ways of requirement definition and stages within the European Space Agency (ESA) Procedures, Specifications, and Standards (PSS-01) series of documents and the NASA Space Station requirements are discussed. A series of adaptations introduced by way of tailoring the basic ESA and NASA requirement sets to the Columbus program's needs are described. For the implementation of these tailored requirements, a scheme is developed, which recognizes the PA/safety approach within the European industries by way of various company handbooks and manuals. The changes introduced in the PSS-01 series and the applicable NASA Space Station requirements in recent years, has coincided with the establishment of Columbus PA/safety requirements. To achieve the necessary level of cooperation between ESA and the Columbus industries, a PA Working Group (PAWG) is established. The PAWG supervises the establishement of the Common PA/Safety Plan and the Standards to be used. Due to the high number of European industries participating in the Columbus program, a positive influence on the evolution of the industrial approaches in PA/safety can be expected. Cooperation in the PAWG has brought issues to light which are related to the ESA PSS-01 series and its requirements. Due to the rapid changes of recent years, basic company documentation has not followed the development, specifically as various recent ESA projects use different project specifc issues of the evolving PSS-01 documents. ESA

N92-18610# Alcatel Espace, Toulouse (France).
ESA PSS AND SCC SPECIFICATIONS IN NON ESA PROGRAMMES **c38**
J. L. Septfonds *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 17-19 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

The realization of high reliability hardware for space applications requires that the manufacturer use international quality standards for the design, selection, and qualification of parts, materials and processes, and in the manufacturing. The product assurance philosophy based on ESA standards, namely Procedures, Specifications, and Standards (PSS) and SCC specifications, has led to contract problems with non-ESA programs in the areas of design, cost, and scheduling. The main discrepancies, identified during a space project, between ESA standards and other standards (in particular U.S. MIL standards) are outlined according to the various activities of product assurance: the data base used for reliability calculations is different; materials used in Europe are, in some cases, rejected on the basis of U.S. reference data (ESA qualified processes are not automatically accepted and additional tests are often required); SCC qualified parts are not considered equivalent to E.R. MIL parts and therefore the screening

has to be systemically amended to comply with MIL specifications); a different approach for manufacturing quality assurance must be considered. Recommendations to help the non-European customers gain more confidence in the ESA standards system are put forward. ESA

N92-18611# Indian Space Research Organization, Bangalore. Satellite Centre.
SPACE PRODUCT ASSURANCE MANAGEMENT STRATEGIES FOR THE 1990S **c38**
K. R. Ramgopal *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 21-25 (For primary document see N92-18607 09-31)
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Space product assurance management in the 1990s is discussed in terms of the difficulties with innovations in technology. The established norm in space technology, that only the tried and tested technology can be considered for operational space missions, is gradually giving way to accepting new technology. The practical difficulties of establishing a heritage with new technologies are discussed. It is concluded that it is necessary for space product assurance to be used to identify levels of participation in the management of technology vital to the mission. This interaction is important because, product assurance personnel, by virtue of their training, experience, and an innate feel for what could constitute a failure, can meaningfully complement even the best design and manufacturing efforts. ESA

N92-18612# Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan.
IMPROVING COST/EFFICIENCY: HOW WE ACT IN PRACTICE **c38**
F. Ciotola and S. Ronchi *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 27-33 (For primary document see N92-18607 09-31)
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Policy regarding improvement of the cost/efficiency ratio is described. Some details about the activities carried out and the results obtained are presented. The company's quality policy and its evolution throughout the years is discussed. The plan established in 1987, aimed at putting the policy into practice, is described. The plan foresees a list of actions, divided for simplicity into 22 steps, to be carried out over a three year period, under continuous monitoring of quality and poor quality costs, in order to identify improvements. Four of the most important steps are described in detail. ESA

N92-18613# Alenia, Torino (Italy).
PRODUCT ASSURANCE APPROACH FOR FUTURE SPACE PROJECTS **c38**
Giovanni Surbone and Marcello Scolaris *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 35-42 (For primary document see N92-18607 09-31)
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The motivation that leads some organizations to seek quality in their products, the management commitment to quality, and the management conditions necessary to achieve high quality potential in a space project are discussed. The evolution of quality in the space project life cycle is analyzed and the argument demonstrates the need to reinforce the quality commitment by concentrating product assurance efforts on preventive actions during the early program phases to enhance success in terms of high product quality level commensurate with cost and schedule constraints. Program success is achievable only through the efficient flow of the entire process. It is shown that the culture of excellence is obtainable only when the responsibility for quality achievement is expanded beyond the quality function to the total organization. The establishment of company quality manuals and procedures applicable to the organization is shown to be insufficient to guarantee excellence. The instilling of the quality mentality must be fully supported by appropriate tools, training in quality techniques, and development of behavioral characteristics (pride, attitude, cooperation, team work, etc.), which will encourage people to perform and enjoy their work and improve themselves. ESA

N92-18614# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.
SAFETY RISK ASSESSMENT FOR ESA SPACE PROGRAMMES
C. Preyssl, M. Panicucci, and P. Peltonen *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 43-49 (For primary document see N92-18607 09-31)
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Risk assessment in the probabilistic evaluation of accident scenarios is discussed. The methodology involves the determination and propagation of event probabilities to calculate risk as a function of consequence severity and probability. Expert judgement is used in a structured way. Risk assessment results are used for the prioritization and optimization of risk reduction efforts and allocation of resources. ESA

N92-18615# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Space Communications and Propulsion Systems.
CONSIDERATION OF LEGAL ASPECTS VERSUS MANAGERIAL NEEDS OF PROCUREMENT ASSURANCE **c38**
Wolf-Dieter Pilz *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 51-55 (For primary document see N92-18607 09-31)
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Quality features not accessible for inspection such as reliability, absence of hydrogen embrittlement, stress durability, or environmental resistivity, are discussed. The example of screw fasteners is used to show that legislation and justice impute a bilateral legal relation between the manufacturer or seller on one side, and the customer or user on the other side, in order to distribute the technical risks on both parties. Modern industrial structures are characterized by interconnected chains of multiple manufacturer/customer relations. Since certain product characteristics (e.g., strength of the welding seam of a pressure vessel or the confidence on a vacuum melted material) cannot be proven on the product itself, the quality of the manufacturing process must be traceable and kept under reasonable control. Procurement assurance as the most suitable managerial measure to reduce the technical risks inherent to any product manufactured or procured is discussed. Legislation and justice is surely helpful to distribute the legal liability for technical risks; on the other hand, this practice prevents essential managerial methods which are necessary to minimize technical risks. Today's achievements in space technology are inconceivable when the technical risks involved are not reduced by means of suitable managerial methods of quality engineering. The conflicts existing between legal aspects and managerial needs of procurement assurance are discussed. ESA

N92-18616*# National Aeronautics and Space Administration, Washington, DC.
LESSONS LEARNED AND THEIR APPLICATION TO PROGRAM DEVELOPMENT AND CULTURAL ISSUES **c81**
Gilbert L. Roth *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 57-60 (For primary document see N92-18607 09-31)
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The main objectives of space product assurance are, in effect, the same as those of Total Quality Management (TQM) or its many variants. The most significant ingredients are the lessons learned and their application to ongoing and future programs as they are affected by changes in the cultural environment. The cultural issues which affect almost everything done in technical programs and projects are considered. Understanding the lessons learned and the synergism which results from this combination of knowledge, culture, and lessons learned is identified as crucial. A brief discussion of the closed loop linkage that should exist between

the world of hands on activities and that of educational institutions is presented. ESA

N92-18617*# National Aeronautics and Space Administration, Washington, DC.
NASA PRODUCT ASSURANCE IN THE 1990S c38
George A. Rodney and James H. Ehl *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 61-65 (For primary document see N92-18607 09-31)
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The objectives of NASA product assurance in the 1990s are identified. They are to provide for personnel safety, and safe and reliable operation of hardware and software during the lifetime of a program or mission. The NASA product assurance program, a multi-discipline effort that focuses on safety, reliability, maintainability, and quality assurance expertise to meet NASA operational requirements is described. This program supports NASA 's unmanned launch vehicles such as satellites and planetary probes, manned spacecraft (such as the Space Shuttle and Space Station Freedom), and ground support equipment. ESA

N92-18618# Bureau Veritas, Courbevoie (France).
ORGANISATIONAL ROBUSTNESS FOR MANNED SPACE FLIGHT
R. Record and J. L. deMontlivault *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 67-70 (For primary document see N92-18607 09-31)
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In manned space programs the requirements for safety are considerably more stringent than those placed on earlier European space programs. Safety must be taken into account not simply during launch site operations but throughout the entire mission. Additionally, safety has become an important constraint at all phases of the project. The main threat to safety is organization malfunction. Development of an organization sufficiently robust to withstand such malfunctions is identified as an essential step towards the achievement of an acceptable level of safety. The safety approach envisaged for the manned space program is compared with that established for civil aviation. Organizational characteristics favorable for the achievement of safety are identified. ESA

N92-18619# Aerospatiale, Cannes (France).
CRITICALITY MANAGEMENT IN SPACE PROGRAMS c81
J. Charron, B. Marguerin, A. Benes, and D. Gonzalez *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 71-77 (For primary document see N92-18607 09-31)
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To cope with the ever increasing complexity of space systems and economic constraints, the Aerospatiale company has developed Critical Items Ranking by Contribution Evaluation (CIRCE), a management model for critical items. The principle of CIRCE is based on a qualitative system approach, and on analysis of the products' environments. Using the proposed model, a program's critical items can be selectively ranked and optimal tradeoffs for actions to be taken during a program can be made visible to its program manager. Thanks to its high sensitivity and dynamic aspect, CIRCE is a true management tool. ESA

N92-18620# Societe Europeenne de Propulsion, Vernon (France).
PRODUCT ASSURANCE AND QUALITY [ASSURANCE PRODUIT ET QUALITE DU SYSTEME INDUSTRIEL] c38
R. Heidmann and R. Vogin *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 79-83 In FRENCH (For primary document see N92-18607 09-31)
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The need to ensure product quality is stressed. The quality of the industrial system making the product must be carefully monitored. This monitoring must be carried out on an organizational level, a procedural level, an economic level, and a human level. To ensure that a high level of quality is maintained, the use of a quality driver system is recommended. The quality analysis stages involved in such a quality driver system are outlined. ESA

N92-18621# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Product Assurance Support.
ORGANIZATIONAL ASPECTS FOR PREVENTING HUMAN FAULTS IN SPACE SYSTEMS: SYSTEMS ENGINEERING APPROACHES TO TOTAL QUALITY MANAGEMENT c38
Hans Joerg Keller *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 85-90 (For primary document see N92-18607 09-31)
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During the development of product (quality) assurance the problem of human behavior was nearly ignored in the past. The urgent need for such assurance is revealed by various catastrophic events caused by human failures. On the basis of the fundamental systems engineering concept of interacting cybernetic control loops, approaches for improving the quality of human action resulting in Total Quality Management (TQM) principles are presented. In a first approach considering the modes of human orientation in a surrounding environment, motivational top down conclusions are drawn. A second bottom up approach based on individual failure causes is used as a standard model of individual responsibility. A more general collective tree model of systems engineering tasks provides preliminary surveying on problem roots and respective problem solving branches, which are further broken down. Both are bound together by a trunk of interactive control loops, structured top down to elementary activities of sufficient transparency and related precautionary principles. A more specific deployment of measures with respect to a specific group of space programs (e.g., manned) requires additional effort. ESA

N92-18622# Aerospatiale, Cannes (France).
QUALITY-COMPLEXITY-COMPETITIVITY TOWARDS IMPROVED INTEGRATION OF PRODUCT ASSURANCE c38
J. Germain and J. L. Douliery *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 91-94 (For primary document see N92-18607 09-31)
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Confronted with the challenge of conducting technically complex space programs under stringent schedule and budget constraints, Aerospatiale has developed a set of tools and methodologies aimed at helping the management of such programs in all domains of activities involved. Aerospatiale has launched an extensive sensitization and education effort so that all employees in the company may contribute more efficiently to its overall competitivity. Detail of the efforts carried out within the organization are presented. ESA

N92-18623# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
THE NEED FOR ACTIVE SOFTWARE PRODUCT ASSURANCE MANAGEMENT FOR SYSTEMS CRITICAL SOFTWARE c61
Richard Borcz *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 97-102 (For primary document see N92-18607 09-31)
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The quality, reliability and safety impact of space systems software is a major concern. Critical functions of systems are increasingly dependent on software. Should a software failure occur in a critical function there is the potential of harm to human life system loss, long term environmetal damage or considerable financial loss. If high integrity software is needed for systems critical operation it is argued that product assurance management for software must move from a classical passive role to an active mode. Experiences in moving into an active product assurance mode for software are presented. ESA

N92-18624# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne (Germany, F.R.).
SYSTEM SAFETY APPROACH IN MANNED SPACELAB MISSIONS FOR CONTROL OF HAZARDS BY SOFTWARE
D. Bohle, W. Ziesmann, and W. Martin (Dornier System G.m.b.H., Friedrichshafen, Germany, F.R.) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 103-108 (For primary document see N92-18607 09-31)
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In European manned missions, hazard control of safety critical systems are not realized entirely by software. At least one hardware inhibition exists. With the increasing capabilities of microprocessor systems, more and more hazards are controlled by S/W (software) in addition to be required H/W (hardware) inhibit. In previous missions this has been the exception. Wherever fault tolerance had to be assured, a failure of the S/W control meant termination of the mission for the affected facility. From a performance point of view this is a very undesirable solution. A software feature developed to overcome this situation in order to gain flexibility and to increase performance reliability is described. The necessary steps in safety certification are discussed using the D2 facility GFQ (Gradient Furnace with Quenching) as an example. An overwiew of S/W safety in space station applications is presented. ESA

N92-18625# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
SOFTWARE PRODUCT ASSURANCE: CURRENT SITUATION AND FUTURE TRENDS WITHIN EUROPE SPACE ACTIVITIES **c38**
H. Norrenbrock *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 109-114 (For primary document see N92-18607 09-31)
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Based on the fact that more and more system aspects are to be implemented via the use of software based systems, the importance of standardization and product assurance of software is increasing as well. Various international organizations are defining software related standards. The current international standards are used to derive the Columbus software product assurance program. Although a lot of work has been done, some areas of concern still remain. Resolution of the highlighted open fields and coverage of future trends is predicted to influence the work of the software product assurance community. ESA

N92-18626# Canadian Space Agency, Ottawa (Ontario).
CANADIAN SPACE STATION SOFTWARE PRODUCT ASSURANCE PROGRAM **c38**
Richard Storm and Michael Evans (Computers and Concepts Associates, Ontario) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 115-120 (For primary document see N92-18607 09-31)
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Innovative Software Product Assurance (SPA) procedures applied to the development of the Mobile Servicing System (MSS), including the Space Station Remote Manipulator System (SSRMS), are discussed. Successful implementation of the MSS requires development of state of the art robotic hardware controlled through approximately 50,000 lines of Ada code and formware. The MSS must perform reliably and consistently within stringent safety, interface, and performance constraints as specified. In order to assure the software products during specification, development, and test, the Canadian Space Agency (CSA) has applied an active and effective SPA program to the prime contractor and each of seven subcontractors supporting the project. The MSS SPA approach utilizes an integrated set of reviews, inspections, audits, and independent assessments of the LSS products and the processes used to develop them. The unique methods and tools developed by CSA to support the effort are described. The MSS SPA approach places emphasis on software engineering and software to the systems engineering functions, and the NASA space station project. How these interfaces are defined and assured and what standards had to be developed to enable the various functions are discussed. Lessons learned based on the Canadian Space Station Program (CSSP) experience are discussed. These lessons learned concern experience, corrective action, and results. ESA

N92-18627# Aerosystems International, Yeovil (England).
SOFTWARE DEPENDABILITY ASSESSMENT **c38**
P. L. Helyer and M. M. Burke *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 121-126 (For primary document see N92-18607 09-31)
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Software dependability is proposed as a measure of the uncertainty in the properties and behavior of software. A model developed to provide a basis for quantitative assessment of the likelihood of software failure is described. The assessment is based upon available evidence in the form of support for and support against various software attributes being as intended. The model is implemented as a prototype knowledge based system in the knowledge engineering language FRIL and some preliminary investigations on the model's behavior are conducted. Further work is necessary to establish the culture of software dependability. ESA

N92-18628*# National Aeronautics and Space Administration, Washington, DC.
PRODUCT ASSURANCE MANAGEMENT AND SOFTWARE PRODUCT ASSURANCE **c38**
C. Schneider, G. Borycki, P. Panaroni, M. Surbone, R. Borcz, and A. J. Beddow (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 129-131 (For primary document see N92-18607 09-31)
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The evolution of software assurance is discussed. The definition and implementation of standards are considered. It is recommended that requirements be clarified at the start of a project. The need for quality assurance in hardware is identified as the coming trend in the production of high cost single units which call for eradication of all errors during the early stages of development. The need to apply quality assurance throughout the whole mission is stressed. The dangers of overpricing product assurance services is stressed. ESA

N92-18629# Technical Research Centre of Finland, Tampere. Safety Engineering Lab.
QUALITY ASSURANCE OF SAFETY AND RISK ANALYSIS **c38**
V. Rouhiainen and J. Suokas *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 135-140 (For primary document see N92-18607 09-31)
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Safety and risk analysis forms an essential part of the implementation of the ESA system safety program requirements. In a major attempt to promote high quality levels, a set of standards and guidelines on hazard identification and risk assessment is presented. The application of safety and risk analysis continues to increase in the process industries. However, the increasing application of risk assessment incurs the need for more precise knowledge of the limitations of the different risk analysis methods and for more explicit definitions of the acceptable levels of detail of both the analysis and the documentation required. The main problems encountered in the field are the quality of the analyses and the resources needed for the analyses. A new method QUASA (Quality Assessment of Safety Analysis) is described and preliminary experiences reviewed. QUASA was developed to meet the needs of the process industries. Some possibilities for the adaptation of QUASA to space technology are discussed. ESA

N92-18630# MATRA Espace, Toulouse (France).
SYSTEMS SAFETY: PRACTICAL EVALUATION OF SNEAK CIRCUIT ANALYSIS APPLIED TO CASE STUDIES **c33**

P. Charon, J. M. Jeandupeux, A. LeHenaff, J. Mignot, and O. Nicolas (CEP Systemes, Toulouse, France) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 141-145 (For primary document see N92-18607 09-31)
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The main benefits and questions arising from the application of sneak circuit analysis methods to systems safety studies are discussed. To assess the method, CNES, DGA and ESA gathered to get three case studies performed by Alcatel Espace and Matra Espace. The method is based on the scanning of a clues list in order to point out potential design problems such as sneak paths, and technological or timing compatibility. The activity is organized into five main steps to prepare and report the results. The U.S. standard procedures are compared with the procedure applied to the three cases. ESA

N92-18631# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.
ESA RESEARCH AND DEVELOPMENT STRATEGY ON SNEAK ANALYSIS c33
B. Dore *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 147-152 (For primary document see N92-18607 09-31)
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Sneak Analysis (SA) involves a set of analytical techniques used to identify unintended electrical paths of logic flows which, under certain conditions, can initiate an undesired function or inhibit a desired function. Due to its unique feature (SA allows the identification of system failures that occur in the absence of component failures) ESA intends to apply SA to selected safety critical functions. The research and development undertaken by ESA in order to support industry in the development of the ESA capabilities needed for the ESA programs is outlined. Training course organization, pilot applications, integration of SA with other Reliability, Availability, Maintainability and Safety (RAMS) techniques, development of computer tools, and production of technical guidelines are discussed. ESA

N92-18632# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
PRODUCT ASSURANCE AND SAFETY IMPLEMENTATION ON SPACE SHUTTLE PAYLOADS: AN INDUSTRIAL PERSPECTIVE c38
Ian Jenkins *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 153-158 (For primary document see N92-18607 09-31)
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Experiences and observations gained in the Product Assurance (PA) and safety field in processing Space Shuttle payloads are summarized with a view to providing some direction for future programs as Europe begins to implement its own manned space ventures. A summary of Space Shuttle payloads at MBB is presented. The PA and safety requirements used are specified. Experiences in management of a safety assurance program in a commercial environment are provided, and oversight of PA and safety aspects in externally furnished equipment are explained. Experiences and trends with Space Shuttle payload safety reviews are discussed. ESA

N92-18633# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
RELIABILITY MODELING FOR NON-ELECTRONIC SYSTEMS c38
N. Valisena and T. deMollerat (Aerospatiale, Cannes, France) *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 159-163 (For primary document see N92-18607 09-31)
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An original approach for reliability modeling of nonelectronic systems is described. Failure rate models are not used in this approach as they are relatively undependable in this area. Specific models, depending on both design margins and quality provisions for realization aspects, are proposed. Examples of such models and rules of combination of the models at system level are given. The results of research conducted on typical probabilities, in space operations, for human errors/inspection efficiencies are presented. ESA

N92-18634# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
A MANAGERIAL APPROACH FOR RELIABILITY VERIFICATION OF MECHANICAL EQUIPMENT c81
Gerhard Albrecht *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 165-167 (For primary document see N92-18607 09-31)
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The verification of the required reliability of mechanical equipment is a difficult task in space programs since adequate statistical failure data covering the specific properties of mechanical equipment is usually not available. However, since straightforward demonstration of the reliability (reliability testing) for the individual equipment is not feasible in most cases for cost and time reasons, effective Reliability, Availability, Maintainability, and Safety (RAMS) management is needed to verify the reliability using test data and other available data. ESA

N92-18635# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SAFETY RISK MANAGEMENT FOR ESA SPACE SYSTEMS
K. M. Wright *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 169-174 (For primary document see N92-18607 09-31)
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ESA's safety program as defined in ESA PSS-01-40, system safety requirements for ESA space systems, comprise the systematic identification and evaluation of space system hazardous characteristics and their associated risks, together with a process of safety optimization through hazard and risk reduction, and implementation verification. This safety optimization and verification process is termed safety risk management. The fundamental principles of safety risk management are discussed. ESA

N92-18636# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
INTEGRATION OF RAMS ACTIVITIES DURING THE DEVELOPMENT PHASE OF ARIANE-5 COMPONENTS (EXAMPLE: VULCAIN THRUST CHAMBER) c20
Claudia Lex *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 175-178 (For primary document see N92-18607 09-31)
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In order to assure the implementation of Reliability, Availability, Maintainability and Safety (RAMS) aspects at an early stage and during the complete development of a product, appropriate tools have to be set up for a proper RAMS management function. The policy and methodology applied for management of RAMS information within the VULCAIN thrust chamber development are described. The performance of the described activities is defined by a dedicated RAMS plan for Ariane 5 propulsion projects at MBB-OTN which meets the requirements of the relevant management specifications for RAMS (dependability) established by CNES for Ariane 5 projects. The described activities are under the responsibility of the RAMS manager for the VULCAIN thrust chamber who is coordinating all RAMS assurance project activities at MBB and at the subcontractors. The RAMS manager is integrated by the project team in order to ensure effective work for RAMS and risk avoidance. The VULCAIN thrust chamber forms part of the cryogenic main stage engine provided for Ariane 5. Its

development is performed as an ESA program under the leadership of the CNES. The engine is under the responsibility of SEP who has subcontracted the thrust chamber to MBB-OTN. ESA

N92-18637# Technische Univ., Delft (Netherlands). Dept. of Mathematics.
WHY QUANTIFY RISK?
R. Cooke, B. Frisch, and A. Saleem (Osterreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna, Austria) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 179-183 (For primary document see N92-18607 09-31)
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The topic of risk to human life is addressed from different viewpoints. The question is raised whether risk assessment is good only as a tool for ranking risk sources or whether it actually yields sensible numbers for estimating the risk of events. Various measures for the quantification of risk (e.g., deaths per million, activity specific hourly mortality rate) are given and their applications are discussed. The implications of the different uses for risk numbers are explained. Known risks of several activities are used as a baseline for the discussion of the selection criteria for an achievable safety goal for manned space flight. ESA

N92-18638# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsions Div.
CONSTRAINTS AND DIFFICULTIES IN IMPLEMENTATION OF RAMS ASSURANCE PROGRAMMES **c38**
Miodrag Culjkovic *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 185-187 (For primary document see N92-18607 09-31)
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A summary is given of typical difficulties in the implementation of Reliability, Availability, Maintainability, Safety (RAMS) assurance programs as observed in numerous space companies during the past ten years. An attempt is made to suggest possible solutions for each listed problem in order to improve the situation and support a more effective RAMS assurance management in the years to come. ESA

N92-18639# Technische Univ., Delft (Netherlands).
RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND SAFETY Abstract Only **c38**
A. Hale, G. L. Roth, M. Culjkovic, P. Charron, and K. Wright (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 191 (For primary document see N92-18607 09-31)
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The role of Reliability, Availability, Maintainability and Safety (RAMS) engineers in space programs is discussed. Difficulties that management have in dealing with risk reduction are considered. The problem of convincing designers that the RAMS engineers are not offering only criticism but an additional viewpoint that improves design quality is discussed. It is recommended that RAMS engineers spend more time on modeling an analysis. As 80 pct. of decisions are made in the first 10 pct. of the work, the need to develop fast and effective models is stressed. ESA

N92-18640# Saab Space A.B., Goeteborg (Sweden). Product Assurance Dept.
IMPLEMENTATION OF THE TOTAL QUALITY MANAGEMENT CONCEPT WITHIN SPACE BUSINESS **c81**
Claes Berlin *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 195-202 (For primary document see N92-18607 09-31)
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During the 1980's the quality task within industry developed into Total Quality Management (TQM). TQM includes the complete operational quality process in the company. The basic elements of TQM are summarized. The TQM concept is defined. Top executive management TQM commitment and involvement of all employees in the TQM process is called for. Concepts, methods and strategies of TQM are presented based on five years of experience in an ongoing process at Saab Space. ESA

N92-18641# British Aerospace Public Ltd. Co., Stevenage (England). Communications Satellite Div.
PRODUCT ASSURANCE: MOVING TOWARDS TOTAL QUALITY **c38**
Stan Wilson *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 203-206 (For primary document see N92-18607 09-31)
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The methods and standards which form part of product assurance within the space industry have developed through an evolutionary process and are continuing to evolve. A new approach designed to take over the product assurance function within both customer and supplier organizations into the 1990's, with a changed emphasis, is described. A brief explanation is given of the key concepts of total quality: a focus of the adoption of new attitudes at all levels of an organization to better their performance by continuous improvement. The approach that the author's company adopted at the beginning of its own total quality campaign is described. ESA

N92-18642# Telesat Canada, Ottawa (Ontario).
SPACE PRODUCT ASSURANCE FOR THE 90'S: IN TRANSITION OR DECLINE? **c38**
Sean Paul Silke *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 207-211 (For primary document see N92-18607 09-31)
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The Challenger disaster, the Hubble spacecraft problems, launch vehicle failures, numerous (early) in orbit spacecraft problems, the associated uncertainty and rocketing insurance costs plague the space industry. These are all quality problems in one form or another. The Product Assurance (PA) function (the traditional champion of quality) appears tarnished. The justification of this criticism is examined. The PA function in a changing world is discussed. ESA

N92-18643# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France). Div. Propulsion a Poudre et Composites.
THE COMPUTERIZED MANAGEMENT OF TECHNICAL DATA: TECHNICAL MEMORY OF THE INDUSTRIAL ENTERPRISE **c81**
J. Nuyts and A. Costecalde *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 219-223 (For primary document see N92-18607 09-31)
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Confronted with more and more severe requirements as far as productivity, quality and reactivity are concerned, industrial enterprises, in ever increasing numbers, have become aware of the importance of a rigorous management of their industrial information systems as a factor of competitivity. Any approach that aims at integrating data processing along the design/manufacturing cycle of the products has to be based on a global management of technical data appealing to rigorous and general concepts. Such management must have the following objective: it must form the basis of the information system. This foundation must enable the management of all technical data relative to design, manufacturing and follow up of all the technical products of the enterprise at all the stages of their conception, according to consistent concepts that are common to all the actors of the company. A technical data management software package called GOT, able to meet these objectives, is described. ESA

N92-18644# Societe Europeenne de Propulsion, Vernon (France).
PAST-EXPERIENCE DATA BANKS **c82**
J. C. Derbes and G. Sciez *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991

p 225-227 (For primary document see N92-18607 09-31)
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Development of rocket engines requires leading technologies which are difficult to master and costly to test. It is necessary to exploit and analyze the failures, mistakes or incidents met during the development of a new engine, to extract the information applicable to the use of similar hardware. Feedback from experience, if properly structured, enables you to intervene as early as tradeoff. This approach is useful in conception stages and organizes failure corrections during maturity. At the end of development it enables you to determine product reliability and prepare for future experimentation. ESA

N92-18645# Alenia, Torino (Italy).
A PRODUCT ASSURANCE ENGINEERING CONCEPT FOR COMPLEX SPACE SYSTEMS **c38**
Mario Ferrante and Danilo Foltran *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 229-236 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

With the increase in complexity of each generation of space system infrastructures and the associated increase in cost and risks, the reliability, availability, maintainability, and safety (RAMS) disciplines are becoming very important as design drivers in assuring the definition of system architectures which are truly optimized for redundancies, mass, cost, and other resources. A product assurance engineering concept developed with the intention of influencing system design and development from the early phases of the project that ensures the incorporation of RAMS requirements into the system architecture is described. The methodology used to establish a space system architecture through analysis based on functions tree, functional Failure Mode Effect and Criticality Analysis (FMECA), software criticality analysis, and critical functions list is described. It is shown how these analyses are used to generate the RAMS requirements to be applied to the system and subsystems. ESA

N92-18646# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
A PROGRAMMATIC APPROACH TO THE WORST CASE ANALYSES
C. Milan *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 237-238 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

The objectives and scope of a worst case analysis (WCA) and its usefulness in verification analysis are described. In order to use this tool in a cost effective way, programmatic decisions are necessary, specifying the applicability of WCA. The important decision criteria are given, and programmatic risks are highlighted. This presentation does not go into procedural details for performing a WCA, but some useful simplifications are shown. ESA

N92-18647# Agusta Sistemi S.p.A., Tradate (Italy). Systems and Space Business Unit.
RAMREQ: A COMPUTERIZED TOOL FOR THE DEFINITION OF RAM (RELIABILITY, AVAILABILITY, MAINTAINABILITY) REQUIREMENTS OF COMPLEX SYSTEMS **c61**
P. Camerino *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 239-247 Sponsored by ESA/ESTEC (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

The software package RAMREQ developed to define the RAM requirements of complex systems (helicopters, aircrafts, and space systems) by the integration of appropriate deductive (top down) and inductive (bottom up) techniques is described. The approach and the mathematical models of RAMREQ, and its preliminary software requirements, were developed under contract for ESA/ESTEC. The validation of the method is carried out in defining the RAM requirements for Hermes. The overall logic flow of the RAMREQ software tool is split into three main processes: the top down RAM apportionment process which makes use of preliminary system information; the bottom up RAM prediction process which makes use of conventional RAM prediction and modeling techniques; and the comparison, assignment, and feedback process which provides the final outputs, and controls the whole model by continuous feedback and cost optimization. These three processes are described in detail. ESA

N92-18648# Exeter Univ. (England). School of Engineering.
RELIABILITY MODELING OF THE SYSTEMS WHOSE COMPONENTS HAVE NON-CONSTANT FAILURE RATE **c38**
J. Knezevic *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 249-252 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

A method for the reliability modeling of future systems whose modules, parts, and components demonstrate non-constant failure rates is described. The method is particularly important for spacecraft which represent a very complex engineering system whose reliability characteristics are as important as performance and cost. The approach presented is demonstrated through a numerical example. ESA

N92-18649# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
SPECIFYING PA/SAFETY DESIGN TO REQUIREMENTS FOR THE COLUMBUS PROJECT AND GENERAL CONCLUSIONS
M. Kasper and W. Gericke (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 253-258 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

Product assurance (PA) and safety design to requirements are provided by the System Requirements Document (SRD) on the system level. These system level requirements contain technical requirements related to reliability, availability, maintainability, safety, PMP, and EEE parts in dedicated sections. In order to implement these requirements, the contractor needs to elaborate and refine them for the detailed design of the system. The requirements are to be apportioned further when establishing system, subsystem, and equipment level specifications. The Columbus process for establishing, refining, and tracing the requirements from ESA generated sets to industry (prime and lower tier contractors) generated design control requirements is described. ESA

N92-18650# Alcatel Espace, Toulouse (France).
FUTURE TECHNOLOGIES FOR SPACE: NEW PRODUCT ASSURANCE CONCEPTS
Guy Gregoris and Sabine Robichez *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 259-266 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

The quality and dependability approach established at Alcatel Espace to face the challenge of using the most advanced technologies in space program is described. From system to component level, the methods developed to comply with the space product assurance requirements are presented. ESA

N92-18651# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
COLLECTION OF PRODUCT ASSURANCE DATA AND THEIR EFFECTIVE UTILIZATION **c38**
L. Haupt *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 267-272 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

A study performed under ESA contract on the subject of Product Assurance Data (PADATA) is described. It starts with the collection of PADATA in the fields of aircraft operations, nuclear, offshore oil, and space industries. The study compares the different

approaches taken and proposes a list of basic objectives for the collection of PADATA. A typical PADATA list and a list of typical PA/QA (Product Assurance/Quality Assurance) functions involved in a space project under ESA Procedure, Specifications, and Standards (PSS) Requirements is presented. Standardization, harmonization, and tailoring of documentation requirements to project needs is discussed. Preconditions of an effective data retrieval system are outlined. Possible approaches to collection of project support data and identification and computerized retrieval of capability data technical memory in the sense of computer aided quality assurance (CAQ) are considered. The study focuses on a proposal for a computer aided flow mapping scheme of the data needed and produced by the typical functions involved in a space project. ESA

N92-18652# Aerospatiale, Blagnac (France). Direction de Programme Hermes.

FACING THE PA TEAM GROWTH PROBLEM IN SPACE PROGRAMS: THE HERMES APPROACH

G. Bernede *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 273-275 (For primary document see N92-18607 09-31)

Copyright Avail: NTIS HC/MF A13

The increasing need for product assurance (PA) in space programs makes finding skilled and trained engineers willing to work in the PA field a top level difficulty. Few engineers are available and exchanging them from one project to another is not a solution. No reservoir of talent exists for the time being in Europe. Educational efforts have started in several countries to have product assurance techniques become part of basic engineering knowledge. These efforts will bring strong improvement compared to today's situation but not in time for programs such as Hermes. Peculiar solutions must be developed. Approaches used to solve this problem within the Hermes program are outlined. ESA

N92-18653# Europea de Tecnologia y Sistemas, Madrid (Spain).

HAZARD ANALYSIS FOR HERMES MISSION TO MTFF

Francois Baudoin *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 277-281 (For primary document see N92-18607 09-31)

Copyright Avail: NTIS HC/MF A13

System hazard analysis performed for the orbital phases of the mission of the Hermes Space Vehicle to the Columbus Man Tended Free Flyer (MTFF) is discussed. The methodology followed, based on a hazard matrix, is described. The list of hazards and system constituents is given. The undesired scenario and proposed corrective actions identified using the hazard matrix are presented. Examples of lists and formats are given. A summary of the methodological lessons learned is presented. ESA

N92-18654# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).

RELIABILITY AND SAFETY ANALYSES OF SYSTEMS USING PETRI NETS **c38**

Juergen Arndt *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 283-288 (For primary document see N92-18607 09-31)

Copyright Avail: NTIS HC/MF A13

Traditional reliability and safety analysis of a system design can hardly consider the dynamic behavior of the system. An approach developed to model and simulate a system with extended Petri nets with the goal of supporting typical features of reliability and safety analyses is presented. The Petri net concepts are briefly sketched and a general modeling scheme is provided. The technique used to simulate failure propagation within systems and the possibility of supporting the safety analysis of a system by analyzing its Petri net model is discussed. The special needs involved in modeling and simulating software design are considered and a modeling scheme based on the HOOD design method is presented. ESA

N92-18655# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.

AN EVALUATION OF PAYLOAD SAFETY REQUIREMENTS FOR ESA MANNED SPACECRAFT

B. Dore, A. Menzel, A. Saleem (Osterreichische Raumfahrt- und Systemtechnik G.m.b.H., Vienna, Austria), and N Watts *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 289-292 (For primary document see N92-18607 09-31)

Copyright Avail: NTIS HC/MF A13

There is a pressing need to establish more specific technical and programmatic safety requirements for certain types of ESA payloads, particularly for those to be utilized on ESA's future manned missions. The applicable safety requirements for each payload depend on many factors peculiar to the individual payload. The nature and purpose of the payload, the type of launcher system foreseen, and the payloads active location, particularly in manned space environment, are some of the principal drivers which may govern both technical and programmatic safety requirements. The future needs within ESA in this area are summarized. ESA

N92-18656# Mirespace, Orleans (France).

MARTA: METHODS FOR ANALYTICAL RELIABILITY AND TEST ASSESSMENT: A SOFTWARE TOOL FOR RELIABILITY CALCULATION OF COMPLEX SYSTEMS **c38**

J. P. Baudet and S. Bianchi *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 293-296 Prepared in cooperation with ESA, Paris, France (For primary document see N92-18607 09-31)

Copyright Avail: NTIS HC/MF A13

The software tool which provides support in reliability analysis activities through the calculation of demonstrated reliability distributions (reliability versus confidence level) of complex systems, by entering the data produced during testing (development tests, qualification tests, etc.) is described. The tool is structured in order to make maximum use of the available information, visibility of analysis, traceability between results and input data entered, and the hypothesis assumed to carry out the calculation. The software has a wide field of application from reliability evaluation, to reliability growth curve, to the simulation of tests to optimize test plans. It is designed to be user friendly, and can be run on any IBM personal computer. ESA

N92-18688# Bettis Atomic Power Lab., West Mifflin, PA.

METHOD AND APPARATUS FOR MEASURING SURFACE CONTOUR ON PARTS WITH ELEVATED TEMPERATURES

Patent Application

M. S. Horvath, inventor (to DOE), R. A. Nance, inventor (to DOE), G. H. Cohen, inventor (to DOE), and G. E. Fodor, inventor (to DOE) 31 May 1990 18 p

(Contract DE-AC11-76PN-00014)

(DE92-003662; US-Patent-Appl-SN-532356;

Patents-US-A7531356) Avail: NTIS HC/MF A03

The invention is directed to a method and apparatus for measuring the surface contour of a test piece, such as the bow of a radioactive fuel rod, which is completely immersed in water. The invention utilizes ultrasonic technology and is capable of measuring surface contours of test pieces which are at a higher temperature than the surrounding water. The presence of a test piece at a higher temperature adversely affects the distance measurements by causing thermal variations in the water near the surface of the test piece. The contour measurements depend upon a constant temperature of the water in the path of the ultrasonic wave to provide a constant acoustical velocity (the measurement is made by the time of flight measurement for an ultrasonic wave). Therefore, any variations of water temperature near the surface will introduce errors degrading the measurement. The present invention overcomes these problems by assuring that the supply of water through which the ultrasonic waves travel is at a predetermined and constant temperature. DOE

N92-18765# National Inst. of Standards and Technology, Gaithersburg, MD.
MATHEMATICAL MODELING OF ENCLOSURE FIRES
H. E. Mitler May 1991 47 p
(PB92-108976; NISTIR-90-4294) Avail: NTIS HC/MF A03 CSCL 13B

After a brief description of the history and physics of enclosure fire modeling, two kinds of deterministic fire models are discussed: field models and zone models. The models consist of sets of coupled equations: differential, algebraic, or a mixture of the two. Special emphasis is placed on discussing some of the numerical techniques used to solve these equations. Although this is not a comprehensive review article, an attempt is made to give a sufficiently complete reference section that the interested reader can follow up on any item. GRA

N92-18766# Florida Univ., Gainesville. Dept. of Civil Engineering.
STRENGTH GAIN AND CEMENTATION OF FLEXIBLE PAVEMENT BASES (REVISED)
W. H. Zimpfer 25 Feb. 1991 73 p Sponsored in part by Florida State Dept. of Transportation, Tallahassee
(PB92-107960; FL/DOT/RMC-286-3287) Avail: NTIS HC/MF A04 CSCL 13B

The strength gain of selected carbonate Florida Department of Transportation (FDOT) flexible pavement base materials is addressed. The gain in strength after aging of base sections constructed in an inside environment and outside environment was measured. Scanning electron microscope (SEM) photographs were also taken and examined to determine changes in structure. The materials investigated were: (1) bank run shell; (2) limerock; and (3) cemented coquina. Strength tests were the Clegg Impact Value (CIV) performed on inside and outside sections and a rigid plate test performed on the inside section. There was a small gain in strength for all three carbonate bases after 22 months. Changes in the matrix particles were observed in the SEM study. The three complementary phases (CIV, plate modulus, and SEM) tend to reinforce each other, indicating a small gain in strength. GRA

N92-18801# Sandia National Labs., Albuquerque, NM.
FLUXLESS LASER SOLDERING FOR ELECTRONIC PACKAGING
F. M. Hosking and D. M. Keicher 1991 11 p Presented at the National Electronics Products Conference (NEPCON) West, Anaheim, CA, 23-27 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-003958; SAND-91-2606C; CONF-920247-1) Avail: NTIS HC/MF A03

Conventional soldering typically requires the use of reactive fluxes to promote wetting. The resulting flux residues are removed primarily with halogenated or chlorofluorocarbon (CFC) solvents. With the mandated phaseout of CFCs by the year 2000, there has been a concentrated effort to develop alternative, environmentally compatible manufacturing and cleaning technologies that will satisfy the restrictions placed on CFCs, but still yield a high quality product. Sandia National Laboratories is currently evaluating a variety of alternative fluxless soldering technologies which can be applied to electronic packaging. Laser soldering in a controlled atmosphere has shown great potential as an environmentally compatible process. The effects of laser heating with a 100 watt CW Nd:YAG laser, joint design, and base/filler metal reactions on achieving fluxless wetting with good metallurgical bonds were examined. Satisfactory Ni-Au plated Kovar (reg sign) solder joints were made with 80In-15Pb-5Ag and 63Sn-37Pb (wt. percent) solder alloys in a slightly reducing cover gas. Wetting generally increased with increasing laser power, decreasing laser beam spot size, and decreasing part travel speed. The materials and processing interaction effects are identified and discussed. DOE

N92-18968# Army Cold Regions Research and Engineering Lab., Hanover, NH. Engineering Lab.
SUBSURFACE DRAINAGE OF PAVEMENT STRUCTURES: CURRENT CORPS OF ENGINEERS AND INDUSTRY PRACTICE Final Report
Wendy L. Allen Dec. 1991 38 p Sponsored in part by FAA and Army
(Contract DTFA01-89-Z-02050)
(DOT/FAA/RD-91/24; CRREL-91-22) Avail: NTIS HC/MF A03

Drainage of pavement structures is recognized as a key factor in improving the performance and extending the maintenance-free life of pavement systems. The use of pavement drainage structures to remove water introduced to the pavement system by surface infiltration, melting of ice lenses formed during freeze-thaw cycles, and ground water sources has become more prevalent during the last decade. The components that make up a well-drained pavement section are commonly known: adequate surface drainage, permeable base courses, filters, and a system of collector pipes. However, the details of the design of these components change with the agency constructing the pavement and the use of the pavement. The criteria and specifications of the Federal and State governments, private industry, and the Corps of Engineers are presented. A comparison of agency practices used in designing pavement drainage systems is presented to show where some design practices may benefit from technologies already accepted by others. Author

32 COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications.

For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking.* For search and rescue see *03 Air Transportation and Safety,* and *16 Space Transportation.*

N92-18008# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
KALMAN FILTER TRACKING OF A REFLECTIVE TARGET USING FORWARD LOOKING INFRARED AND DOPPLER RETURN MEASUREMENTS M.S. Thesis
Theodore D. Herrera Dec. 1991 451 p
(AD-A243563; AFIT/GE/ENG/91D-25) Avail: NTIS HC/MF A20 CSCL 17/9

Plume phenomenology experiments conducted in 1990 uncovered the existence of plume speckle reflectance emanating from the exhaust of a solid-propellant rocket motor due to the presence of metallic particulates in the plume. This impeded attempts, that are dependent upon the speckle return of an actively illuminated target hardbody, to discern the plume/hardbody interface. This thesis investigates the feasibility of employing the Doppler return phenomenon in discerning the plume/hardbody interface and locating the hardbody center-of-mass. The potential of the Doppler phenomenon's utilization lies in the fact that the Doppler return frequency spectra of the plume and the hardbody respectively possess distinct properties and are differentiable from each other. Hence, these differences can be exploited in the attempt to discern the plume/hardbody interface. For this study, two center-of-mass Kalman filters are developed to receive the Doppler return measurements: a one-state filter and a two-state Modified Maximum a Posteriori Multiple Model Adaptive filter. A sensitivity analysis is conducted wherein the performances of the one-state filter and two-state filter are evaluated with variations in transmitted wavelength, signal-to-noise (SNR), and probability-of-miss. Results show the center-of-mass filters are sensitive to increases in probability-of-miss, whereas decreases in SNR produced insignificant degradation in performance. The two-state Modified MAPMMAF achieved the best performance, and clearly has the potential to accomplish the task of locating and tracking the hardbody center of mass. Author (GRA)

N92-18015# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
RADAR SYSTEM CLASSIFICATION USING NEURAL NETWORKS M.S. Thesis
David M. Cameron Dec. 1991 82 p
(AD-A243631; AFIT/GSO/ENS/91D-03) Avail: NTIS HC/MF A05 CSCL 17/9

This study investigated methods of improving the accuracy of neural networks in the classification of large numbers of classes. A literature search revealed that neural networks have been successful in the radar classification problem, and that many complex problems have been solved using systems of multiple neural networks. The experiments conducted were based on 32 classes of radar system data. The neural networks were modelled using a program called the Neural Graphics Analysis System. It was found that the accuracy of the individual neural networks could be increased by controlling the number of hidden nodes, the relative numbers of training vectors per class, and the number of training iterations. The maximum classification accuracy of 96.5 percent was achieved using a hierarchy of neural networks in which the classes were partitioned based on their performances in a large neural network trained with all classes. Author (GRA)

N92-18035*# Arizona State Univ., Tempe. Dept. of Electrical Engineering.
HIGH-FREQUENCY TECHNIQUES FOR RCS PREDICTION OF PLATE GEOMETRIES Semiannual Progress Report, 1 Aug. 1991 - 31 Jan. 1992
Constantine A. Balanis and Lesley A. Polka 31 Jan. 1992 30 p
(Grant NAG1-562)
(NASA-CR-189884; NAS 1.26:189884) Avail: NTIS HC/MF A03 CSCL 20N

The principal-plane scattering from perfectly conducting and coated strips and rectangular plates is examined. Previous reports have detailed Geometrical Theory of Diffraction/Uniform Theory of Diffraction (GTD/UTD) solutions for these geometries. The GTD/UTD solution for the perfectly conducting plate yields monostatic radar cross section (RCS) results that are nearly identical to measurements and results obtained using the Moment Method (MM) and the Extended Physical Theory of Diffraction (EPTD). This was demonstrated in previous reports. The previous analysis is extended to bistatic cases. GTD/UTD results for the principal-plane scattering from a perfectly conducting, infinite strip are compared to MM and EPTD data. A comprehensive overview of the advantages and disadvantages of the GTD/UTD and of the EPTD and a detailed analysis of the results from both methods are provided. Several previous reports also presented preliminary discussions and results for a GTD/UTD model of the RCS of a coated, rectangular plate. Several approximations for accounting for the finite coating thickness, plane-wave incidence, and far-field observation were discussed. Here, these approximations are replaced by a revised wedge diffraction coefficient that implicitly accounts for a coating on a perfect conductor, plane-wave incidence, and far-field observation. This coefficient is computationally more efficient than the previous diffraction coefficient because the number of Maliuzhinets functions that must be calculated using numerical integration is reduced by a factor of 2. The derivation and the revised coefficient are presented in detail for the hard polarization case. Computations and experimental data are also included. The soft polarization case is currently under investigation. Author

N92-18071 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE BEVERAGE ANTENNA: A PRACTICAL WAY OF ASSESSING THE RADIATION PATTERN USING OFF-AIR SIGNALS
A. G. Lyner 1991 15 p
(BBC-RD-1991/12) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A method was developed for estimating the sensitivity pattern of a Beverage Antenna which makes use of off-air signals which are analyzed statistically by computer. The analysis software is in a portable form which could be run by any computer with reasonable performance. The results obtained by the method agree sufficiently well with theory to justify the method. When used to compare the performance of a high wire antenna with a low wire antenna, the method confirmed that the sensitivity pattern, at HF, is better for a low wire. It is recommended that a similar method should be used to assess the actual performance of the antennas at Crowsley Park. Author

N92-18072 British Broadcasting Corp., Kingswood (England). Engineering Div.
FIELD STRENGTH PREDICTION FOR VHF/UHF TERRESTRIAL BROADCASTING AND MOBILE RADIO SERVICES
R. S. Sandell, R. W. Lee, and C. P. Bell 1991 40 p
(BBC-RD-1991/11) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

A large quantity of VHF/UHF field strength measurements, the majority being made within the UK, were examined. Many of these were used in the construction of the original Consultative Committee for International Radio (CCIR) curves from which the existing prediction technique of Section 5D of CCIR Vol 5 developed. The extent of the errors of the present CCIR technique was evaluated. An important conclusion reached here is that reasonable accuracy can be reached with comparatively little information concerning the propagation path. This observation has led to the proposal for a new technique employing a coarse data base capable of revealing important features in the path, but embracing an end correction which takes full account of the vital details close to the terminals. The accuracy of such a system was demonstrated using the UK measurements, and it is considered that scope exists for further improvement. Finally, the data which was collated in this project over the past four years offers a substantial resource for further examination of VHF and UHF. Author

N92-18117 British Broadcasting Corp., Kingswood (England). Engineering Div.
METHODS OF MEASURING AND CALCULATING DISPLAY TRANSFER CHARACTERISTICS (GAMMA)
A. Roberts 1991 17 p
(BBC-RD-1991/6) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

It has always been difficult to measure the transfer characteristic of a cathode ray display tube with sufficient precision, because of the problem of accurately setting the black level. To obviate this, a mathematical method was devised which avoids this problem by calculating the black level error from the measured data. Using the same mathematical process, it is also possible to calculate the uncontrolled, or stray, light which was present during the measurement process. In this way it is possible to derive the characteristic of the display as a power law (if one exists) with considerable precision. The mathematics involved require computer processing of the data and an optimization routine to provide ever-increasing accurate estimation of the offsets in the data; however, all the processing can be done on a small microcomputer using simple algorithms. Special routines were developed for this and are listed. Author

N92-18121 Department of the Navy, Washington, DC.
ZERO CROSS-CORRELATION COMPLEMENTARY RADAR WAVEFORM SIGNAL PROCESSOR FOR AMBIGUOUS RANGE RADARS Patent
Karl R. Gerlach, inventor (to Navy) and Frank F. Kretschmer, Jr., inventor (to Navy) 10 Sep. 1991 7 p Filed 30 Jan. 1991
(AD-D015141; US-Patent-5,047,784; US-Patent-Appl-SN-647946)
Avail: US Patent and Trademark Office CSCL 17/9

A method and apparatus exploiting the discovery that the crosscorrelation of constantly spaced rows of the matrices representing certain pulse codes sum to zero. In a ranging system, such as a radar system, pulses are coded according to the rows of such a matrix, transmitted sequentially, and each return is processed sequentially through a filter matched to one of the coded pulses (a different preselected filter is used for each return).

The sequence of filters is chosen so that for returns for a give range interval, each filter is matched to the representing autocorrelations of the returned pulses. These outputs are coherently time delayed added to form the compressed pulse, and annunciated as a target hit. Should the filters and returns be mismatched, as with ambiguous stationary clutter returns, the outputs of the filters are cross-correlations which, according to said discovery, sum to zero. Thus, the invention operates to remove ambiguous range clutter from returns in such a ranging system. GRA

N92-18206 Department of the Navy, Washington, DC.
SAMPLED DATA PROCESSING Patent
James P. Hansen, inventor (to Navy) 17 Sep. 1991 7 p Filed 23 Sep. 1974
(AD-D015150; US-Patent-5,049,890; US-Patent-Appl-SN-508774; US-Patent-Class-342-384) Avail: US Patent and Trademark Office CSCL 17/9

An improved signal processing system and technique for preprocessing auxiliary data signals by sequential decorrelation, particularly for use in systems employing adaptive canceller loops are described. Each of a plurality of signal channels sample the environment of a plurality of signal sources and provide inputs to a configuration of adaptive canceller loops. The loops are connected such that an adaptive loop decorrelates the signal from two signal channels to form a preprocessed signal, and each of the remaining adaptive loops are sequentially connected such that each auxilliary channel signal is decorrelated from the preprocessed signal of the previous adaptive loop until all signal channels have been utilized. In a side-lobe cancellor system each of the preprocessed outputs is used to form an auxiliary sample input to a main channel canceller loop to cancel interference in the receiving system. By using the preprocessed signals as the auxiliary input, a receiving system can significantly increase interference cancellation and reduce the number of iterations required. GRA

N92-18217*# Ohio State Univ., Columbus. ElectroScience Lab.
PLANAR NEAR-FIELD SCANNING FOR COMPACT RANGE BISTATIC RADAR CROSS-SECTION MEASUREMENT Thesis Final Report
S. R. Tuhela-Reuning and E. K. Walton Nov. 1991 130 p
(Grant NAG3-1125)
(NASA-CR-189833; NAS 1.26:189833; Rept-723105-2) Avail: NTIS HC/MF A07 CSCL 17I

The design, construction, and testing of a low cost, planar scanning system to be used in a compact range environment for bistatic radar cross-section (bistatic RCS) measurement data are discussed. This scanning system is similar to structures used for measuring near-field antenna patterns. A synthetic aperture technique is used for plane wave reception. System testing entailed comparison of measured and theoretical bistatic RCS of a sphere and a right circular cylinder. Bistatic scattering analysis of the ogival target support, target and pedestal interactions, and compact range room was necessary to determine measurement validity. Author

N92-18250 British Broadcasting Corp., Kingswood (England). Engineering Div.
VHF (BAND 2) PROPAGATION TESTS ACROSS THE IRISH SEA
J. Middleton 1991 12 p
(BBC-RD-1991/8) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Measurements of Band II transmissions across the Irish Sea over a 13 month period between 1983 and 1984 were analyzed and compared with prediction methods normally used to calculate interference from broadcast transmissions (BBC and CCIR methods). They were also compared with North Sea measurements made in 1954. The measurements show that both methods predict interference levels which are not seriously in error, any differences which do exist tending to allow a slightly greater degree of protection than may be necessary. Considering how different the two methods are in approach to field strength prediction, it is encouraging to note how closely they agree with each other. When compared with the earlier North Sea measurements, the results show a possible anomaly regarding the effect of transmitter height on received field strength for trans-horizon paths. While not a serious problem, it does raise questions concerning the mechanism of trans-horizon propagation at VHF which cannot be fully explained. Author

N92-18281*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
ANALYSIS OF A GENERALIZED DUAL REFLECTOR ANTENNA SYSTEM USING PHYSICAL OPTICS
Roberto J. Acosta and Alan R. Lagin Feb. 1992 47 p
(NASA-TM-105425; E-6842; NAS 1.15:105425) Avail: NTIS HC/MF A03 CSCL 20N

Reflector antennas are widely used in communication satellite systems because they provide high gain at low cost. Offset-fed single paraboloids and dual reflector offset Cassegrain and Gregorian antennas with multiple focal region feeds provide a simple, blockage-free means of forming multiple, shaped, and isolated beams with low sidelobes. Such antennas are applicable to communications satellite frequency reuse systems and earth stations requiring access to several satellites. While the single offset paraboloid has been the most extensively used configuration for the satellite multiple-beam antenna, the trend toward large apertures requiring minimum scanned beam degradation over the field of view 18 degrees for full earth coverage from geostationary orbit may lead to impractically long focal length and large feed arrays. Dual reflector antennas offer packaging advantages and more degrees of design freedom to improve beam scanning and cross-polarization properties. The Cassegrain and Gregorian antennas are the most commonly used dual reflector antennas. A computer program for calculating the secondary pattern and directivity of a generalized dual reflector antenna system was developed and implemented at LeRC. The theoretical foundation for this program is based on the use of physical optics methodology for describing the induced currents on the sub-reflector and main reflector. The resulting induced currents on the main reflector are integrated to obtain the antenna far-zone electric fields. The computer program is verified with other physical optics programs and with measured antenna patterns. The comparison shows good agreement in far-field sidelobe reproduction and directivity. Author

N92-18312 Department of the Navy, Washington, DC.
BROAD BAND, POLARIZATION DIVERSITY MONOPULSE ANTENNA Patent
Robert G. Corzine, inventor (to Navy), Bruce E. Bolstad, inventor (to Navy), and John S. Johantgen, inventor (to Navy) 4 Jun. 1991 9 p Filed 15 Jan. 1971
(AD-D015167; US-Patent-5,021,796; US-Patent-Appl-SN-106883; US-Patent-Class-343-712) Avail: US Patent and Trademark Office CSCL 17/9

A broadband, polarization diversity, monopulse antenna is disclosed. The antenna is comprised of a body canceled current array and a radial arm-coupled log periodic loop antenna in combination with associated mode forming, beam forming, and feed networks. GRA

N92-18537# Sandia National Labs., Albuquerque, NM.
POLARIMETRIC CALIBRATION OF A COHERENT MEASUREMENT RADAR
B. C. Brock Dec. 1991 59 p
(Contract DE-AC04-76DP-00789)
(DE92-004114; SAND-91-2150) Avail: NTIS HC/MF A04

The polarimetry problem (the measurement of the radar-cross-section polarization scattering matrix) is described. Two methods of calibrating a polarimetric radar are outlined. The first is a general multiple-calibration-target (MCT) method applicable to almost any radar system. The second is a simple, single-calibration-target (SCT) method applicable to systems which use a single antenna for both transmit/receive and a reciprocal RF network. The performance of the MCT method is examined

through the use of Monte Carlo simulations. Finally, the SCT method is applied to measurements from the SCATTER facility, demonstrating about 40 dB isolation between polarization components in the frequency domain and in excess of 50 dB in the range domain. DOE

N92-18599# Sandia National Labs., Albuquerque, NM.
RADAR-CROSS-SECTION MEASUREMENT ERRORS CAUSED BY TEST OBJECT INTERACTION WITH LOW-DIELECTRIC-CONSTANT SUPPORTS
B. C. Brock, W. E. Patitz, K. W. Sorensen, and D. H. Zittel Aug. 1991 27 p
(Contract DE-AC04-76DP-00789)
(DE92-004758; SAND-91-0955) Avail: NTIS HC/MF A03

In the search for an ideal test-object support for simulated free-space radar-cross-section (RCS) measurements, low-density polystyrene foam has achieved considerable popularity. However, significant error can be introduced into a measurement by the use of an inappropriately designed support. Although low backscatter radar-cross-section (RCS) can be obtained with this material, interactions can occur between the test object and the mount which will cause measurement errors in excess of several dB. We present results of measurements performed on a simple test object supported on a low-density foam column which demonstrate this effect. As we discussed, this error can be incorrectly interpreted to be caused by poor mechanical alignment of the test object with the radar-range coordinate system. We discuss trade-offs associated with the choice between electrical and mechanical boresighting of the test object. Finally, we show that the error can be explained by differential propagation effects. In addition, this simple theory provides the insight necessary to devise appropriate measures to minimize the errors caused by the presence of the support. DOE

N92-18866# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Systems and Logistics.
A STUDY OF THE ADOPTION AND EFFECTIVENESS OF ELECTRONIC MAIL AT THE AIR FORCE INSTITUTE OF TECHNOLOGY M.S. Thesis
Douglas D. White Dec. 1991 78 p
(AD-A243865; AFIT/GIR/LSY/91D-13) Avail: NTIS HC/MF A05 CSCL 17/2

This research investigated the relationship between the adoption and effectiveness of electronic mail at the Air Force Institute of Technology's School of Systems and Logistics (LS). In this research, theories concerning innovation adoption and measurement of system effectiveness are discussed. Survey instruments from both areas were selected, tested, and used to collect data from the LS faculty and staff. Correlation analysis was performed using the data collected. Findings indicate a correlation does exist between the adoption of electronic mail and the effectiveness surrogate measurement of user satisfaction. There was a significantly strong negative correlation between electronic mail complexity and user satisfaction. GRA

N92-18917# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
S-BAND ANTENNA FOR THE MECB REMOTE SENSING SATELLITE (SSR-1)
Carlos Alberto Ienna Miranda and Vicente dePaulo Dama daCostaJunior Jul. 1991 14 p Presented at the 1st Simposio Brasileiro de Tecnologia Aeroespacial, Sao Jose dos Campos, Brazil, Aug. 1990
(INPE-5245-PRE/1676) Avail: NTIS HC/MF A03

The Imaging Instrument Subsystem of the first Brazilian Complete Space Mission (MECB) Remote Sensing Satellite (SSR-1) requires the design of a right-handed circularly polarized antenna for data transmission at 2250 MHz. The antenna shall produce a shaped radiation pattern that concentrates the radiated energy into a cone with a full cone angle of 130 degrees corresponding to the coverage region. The optimum is a shaped-conical radiation pattern with a maximum gain at the rim of the cone and gain decreasing to a minimum at the center of the cone to provide uniform signal strength at the receiver throughout the satellite pass. This antenna is to be mounted on the earthward side of the spacecraft within an area defined by the launcher and satellite structural specification. Author

N92-18921*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
LEAST RELIABLE BITS CODING (LRBC) FOR HIGH DATA RATE SATELLITE COMMUNICATIONS
Mark Vanderaar, Paul Wagner (Sverdrup Technology, Inc., Brook Park, OH.), and James Budinger 1992 10 p Proposed for presentation at the 14th International Communications Satellite Systems Conference, Washington, DC, 22-26 Mar. 1992; sponsored by AIAA
(Contract NAS3-25266)
(NASA-TM-105431; E-6848; NAS 1.15:105431) Avail: NTIS HC/MF A02 CSCL 17B

An analysis and discussion of a bandwidth efficient multi-level/multi-stage block coded modulation technique called Least Reliable Bits Coding (LRBC) is presented. LRBC uses simple multi-level component codes that provide increased error protection on increasingly unreliable modulated bits in order to maintain an overall high code rate that increases spectral efficiency. Further, soft-decision multi-stage decoding is used to make decisions on unprotected bits through corrections made on more protected bits. Using analytical expressions and tight performance bounds it is shown that LRBC can achieve increased spectral efficiency and maintain equivalent or better power efficiency compared to that of Binary Phase Shift Keying (BPSK). Bit error rates (BER) vs. channel bit energy with Additive White Gaussian Noise (AWGN) are given for a set of LRB Reed-Solomon (RS) encoded 8PSK modulation formats with an ensemble rate of 8/9. All formats exhibit a spectral efficiency of 2.67 = (log2(8))(8/9) information bps/Hz. Bit by bit coded and uncoded error probabilities with soft-decision information are determined. These are traded with with code rate to determine parameters that achieve good performance. The relative simplicity of Galois field algebra vs. the Viterbi algorithm and the availability of high speed commercial Very Large Scale Integration (VLSI) for block codes indicates that LRBC using block codes is a desirable method for high data rate implementations. Author

N92-18925*# Arizona Univ., Tucson.
AN OVERVIEW OF UNP
Larry L. Peterson 1986 11 p
(Contract NCC2-561; NSF DCR-86-09396)
(NASA-CR-189927; NAS 1.26:189927) Avail: NTIS HC/MF A03 CSCL 17B

A brief introduction to the Universal Naming Protocol (UNP) is presented. UNP specifies a generic attribute-based name server upon which a variety of high-level naming services, including white- and yellow-page services, can be built. Author

N92-18940# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
INVESTIGATION OF THE EFFECTS OF AEROELASTIC DEFORMATIONS ON THE RADAR CROSS SECTION OF AIRCRAFT M.S. Thesis
Samuel D. McKenzie Dec. 1991 133 p
(AD-A243889; AFIT/GE/ENG/91D-40) Avail: NTIS HC/MF A07 CSCL 17/9

The effects of aeroelastic deformations on the radar cross section (RCS) of a T-38 trainer jet and a C-5A transport aircraft are examined and characterized. Realistic representations of structural wing deformations are obtained from a mechanical/computer aided design software package called NASTRAN. NASTRAN is used to evaluate the structural parameters of the aircraft as well as the restraints and loads associated with realistic flight conditions. Geometries for both the non-deformed and deformed airframes are obtained from the NASTRAN models and translated into RCS models. The RCS is analyzed using a numerical modeling code called the Radar Cross Section - Basic Scattering Code, version 2 which was developed at the Ohio State University and is based on the uniform geometric theory of

diffraction. The code is used to analyze the effects of aeroelastic deformations on the RCS of the aircraft by comparing the computed RCS representing the deformed airframe to that of the non-deformed airframe and characterizing the differences between them. GRA

N92-18953# Kohlberg Associates, Inc., Alexandria, VA.
THEORETICAL TECHNIQUES AND COMPUTATIONAL CONSIDERATIONS FOR DETERMINING THE ELECTROMAGNETIC FIELDS OF A BICONICAL ANTENNA WITH RESISTIVE LOADING Final Report, Jun. 1989 - May 1991
Ira Kohlberg Oct. 1991 44 p
(Contract DAAL02-87-C-0052)
(AD-A243814; KAI-TR004-91; HDL-CR-91-052-1) Avail: NTIS HC/MF A03 CSCL 09/1

This study develops a methodology for calculating the fields of a biconical antenna with resistive loading that appears to be computationally feasible. The resistively loaded case is found to require additional terms in the antenna region (compared to the lossless case), so that the interior boundary condition is satisfied. The solution of the interior boundary value equations requires the use of an orthogonal basis of functions in the radial direction, which reduces the problems to one that can be solved in matrix form. The computational implementation of this theory remains to be executed. GRA

N92-18966# Federal Aviation Administration, Atlantic City, NJ.
ECP-27 FINAL TEST REPORT
Wayne E. Bell and John Warren Feb. 1992 17 p
(DOT/FAA/CT-TN92/3) Avail: NTIS HC/MF A03

Given here are the results of the Operational Test and Evaluation (OT&E)/Integration testing of Engineering Change Proposal No. 27 (ECP-27) equipment. The information given is based on test results from five separate test efforts associated with ECP-27 and performed from March 1989 to October 1991. Based on the test results, it is concluded that ECP-27 equipment performed its function of providing data exchange between the National Airspace System (NAS) Radio Communications Link (RCL) facilities and is considered qualified for operational deployment. Author

33 ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry.

For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

N92-18145# California Univ., Berkeley. Lawrence Berkeley Lab.
SUPPRESSION OF MAGNETIC FLUX NOISE IN YBa2Cu3O(7-x) FLUX TRANSFORMERS
M. Ferrari, F. C. Wellstood, J. J. Kingston, M. Johnson, and J. Clarke Aug. 1991 12 p Presented at the 1991 Superconducting Quantum Interference Devices (IC SQUID) Meeting, Berlin (Fed. Republic of Germany), 18-21 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004306; LBL-31157; CONF-9106224-2) Avail: NTIS HC/MF A03

We have constructed hybrid magnetometers by coupling a flux transformer of YBa2Cu3O(7-x) to a Nb-PbIn SQUID. The low frequency (1/f) noise is dominated by fluctuations in the supercurrent circulating in the transformer, driven by vortex motion. The application of a small static magnetic field induces a supercurrent that reversibly suppresses the noise, in quantitative agreement with a model of thermally activated vortex hopping between symmetrical pairs of pinning sites. A persistent current can be used to reduce the low frequency noise power of high-Tc flux transformers by at least one order of magnitude. DOE

N92-18153# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
BATTERY AVAILABILITY FOR NEAR-TERM (1998) ELECTRIC VEHICLES
A. F. Burke Jun. 1991 48 p
(Contract DE-AC07-76ID-01570)
(DE92-003331; EGG-EP-9766) Avail: NTIS HC/MF A03

Battery Requirements were determined for a wide spectrum of electric vehicles ranging from 2-passenger sports cars and microvans to full size vans with a payload of 500 kg. All the vehicles utilize ac, high voltage (340 to 360 V) powertrains and have acceleration performance (0 to 80 km/h in less than 15 seconds) expected to be the norm in 1988 electric vehicles. Battery packs were configured for each of the vehicles using families of sealed lead-acid and nickel-cadmium modules which are either presently available in limited quantities or are being developed by battery companies which market a similar battery technology. It was found that the battery families available encompass the Ah cell sizes required for the various vehicles and that they could be packaged in the space available in each vehicle. The acceleration performance and range of the vehicles were calculated using the SIMPLEV simulation program. The results showed that all the vehicles had the required acceleration characteristics and ranges between 80 to 160 km (50 to 100 miles) with the ranges using nickel-cadmium batteries being 40 to 60 pct. greater than those using lead-acid batteries. Significant changes in the design of electric vehicles over the last fifteen years are noted. These changes make the design of the batteries more difficult by increasing the peak power density required from about 60 W/kg to 100 to 150 W/kg and by reducing the Ah cell size needed from about 150 Ah to 30 to 70 Ah. Both of these changes in battery specifications increase the difficulty of achieving low $/kWh cost and long cycle life. This is true for both lead-acid and nickel-cadmium batteries. DOE

N92-18167 Department of the Navy, Washington, DC.
SOLID STATE MODULATOR FOR MICROWAVE TRANSMITTERS Patent
Jeffrey C. Firman, inventor (to Navy), Richard E. Rouse, inventor (to Navy), and William H. Zinger, inventor (to Navy) 6 Aug. 1991 8 p Filed 8 May 1984
(AD-D015130; US-Patent-5,038,051; US-Patent-Appl-SN-608297)
Avail: US Patent and Trademark Office CSCL 10/2

A switching modulator for a microwave radar transmitter is presented. In one embodiment, a string of series connected transistors is controlled from an external source for pulse modulating the cathodes of transmitter microwave tubes. The individual components of the series string can be individually switched ON or OFF in order to maintain regulation of the modulation pulse. In a second embodiment, a pulse transformer has a plurality of individual primary windings and a single secondary winding wherein the primary windings are specially wound to provide isolation between the primary windings with the flux in the secondary, winding and the voltage generated in the secondary winding and the voltage generated in the secondary winding being proportional to the sum of the excitation of the primary windings. Each of the primary windings are individually switchable for regulating the generated output voltage at the secondary winding. Author (GRA)

N92-18169 Department of the Navy, Washington, DC.
NARROW BAND AUTOMATIC PHASE CONTROL TRACKING CIRCUITRY Patent
Richard C. Goedeke, inventor (to Navy) and Roger L. Peterson, inventor (to Navy) 23 Jul. 1991 6 p Filed 3 Dec. 1973
(AD-D015136; US-Patent-5,034,748; US-Patent-Appl-SN-419151; US-Patent-Class-342-99) Avail: US Patent and Trademark Office CSCL 17/9

The invention disclosed herein relates in general to an improved circuitry for narrow band frequency tracking system for Doppler radar and includes third order phase lock loop circuitry to improve tracking techniques. This enables tracking input frequency

variations caused by target maneuvers with substantially smaller tracker bandwidths than is currently possible. Author (GRA)

N92-18184 Department of the Navy, Washington, DC.
HETEROGENEOUS MAGNETORESISTIVE LAYER Patent
Alan S. Edelstein, inventor (to Navy) 27 Aug. 1991 7 p Filed 13 Aug. 1990 Supersedes N91-19289 (29 - 11, p 1686), AD-D014665
(AD-D015146; US-Patent-5,043,693; US-Patent-Appl-SN-565781; US-Patent-Class-338-32R) Avail: US Patent and Trademark Office CSCL 20/3

A magnetoresistive material includes discrete units of magnetostrictive material separated from one another by one or more gaps. In one class of embodiments, magnetostrictive particles are embedded in a phase-separated nonmagnetostrictive matrix. In one embodiment a magnetoresistive article is made by co-sputtering particles of a magnetostrictive material and a quantity of a nonmagnetostrictive material onto an nonmagnetostrictive substrate. The magnetostrictive particles are spaced from one another by distances in the range of 10 to 100 angstroms. In another embodiment, a magnetoresistive article is made by employing relatively large magnetostrictive electrodes separated by a small gap on a nonmagnetostrictive substrate. Magnetic field sensors employing such articles are also provided. GRA

N92-18196 Department of the Navy, Washington, DC.
FIELD EMITTER ARRAY COMPARATOR Patent
Henry F. Gray, inventor (to Navy) 9 Jul. 1991 6 p Filed 30 Aug. 1990 Supersedes AD-D014689
(AD-D015152; US-Patent-5,030,895; US-Patent-Appl-SN-574858; US-Patent-Class-315-350) Avail: US Patent and Trademark Office CSCL 09/1

A field emitter array comparator is provided wherein voltage or current input signals supplied to at least two deflectors control the selective deflection of a beam of electrons to one collector of a collector array of at least two collectors. The beam of electrons is generated by a source of electrons, such as a field emitter array, in an evacuated chamber, and the at least two deflectors are disposed in preselected positions relative to the electron source. The input signals to at least two deflectors cause deflection of the beam of electrons in the direction of the deflector to which the most positive signal is applied, thus causing the electron beam to strike a collector positioned in the path of the deflected beam. This results in a reduction in voltage associated with that collector. In general, the voltages on the collectors are used to determine whether the signal inputs are equal or, if unequal, which input has the greatest magnitude. Author (GRA)

N92-18202 Department of the Navy, Washington, DC.
INTELLIGENT BATTERY CHARGING SYSTEM Patent
Hobert R. Everett, Jr., inventor (to Navy) 3 Sep. 1991 15 p Filed 14 Nov. 1989
(AD-D015107; US-Patent-5,045,769; US-Patent-Appl-SN-436277; US-Patent-Class-320-2) Avail: US Patent and Trademark Office CSCL 10/3

The present invention is a battery charging system that provides automatic voltage selection, short circuit protection, and delayed output to prevent arcing or pitting. A second embodiment of the invention provides a homing beacon which transmits a signal so that a battery powered mobile robot may home in on and contact the invention to charge its battery. The invention includes electric terminals isolated from one another. One terminal is grounded and the other has a voltage applied to it through a resistor connected to the output of a DC power supply. A voltage scaler is connected between the resistor and the hot terminal. An On/Off controller and a voltage mode selector sense the voltage provided at the output of the voltage scaler. GRA

N92-18205 Department of the Navy, Washington, DC.
METHOD FOR THE SELECTING SUPERCONDUCTING POWDERS Patent
Inna G. Talmy, inventor (to Navy), Curtis A. Martin, inventor (to Navy), and Kurt P. Scharnhorst, inventor (to Navy) 10 Sep. 1991 10 p Filed 19 Jan. 1988
(AD-D015129; US-Patent-5,047,387; US-Patent-Appl-SN-145172; US-Patent-Class-505-1) Avail: US Patent and Trademark Office CSCL 13/8

An invention for the beneficiation of powered material having superconducting characteristics is described. The invention involves introducing powdered superconducting material into the vertical field of a magnet where the particles of the powdered material are levitated according to the Meissner Effect. Particles which are more superconducting levitate at higher elevations or levels above the magnet than do particles containing phases that are non-superconducting. Particles that are non-superconducting do not react at all in the magnetic field. Levitated particles are selectively harvested from the desired levels. Author (GRA)

N92-18216# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
DESIGN AND IMPLEMENTATION OF SELF-TUNING ACTIVE NOISE CONTROL SYSTEMS
M.O. Tokhi and R.R Leitch (Heriot-Watt Univ., Edinburgh, Scotland) May 1991 35 p
(RR-427; ETN-92-90649) Avail: NTIS HC/MF A03

A design method for Active Noise Control (ANC) systems in a three dimensional non-dispersive (linear) propagatation medium with compact broadband noise sources is presented. The design and implementation of the controller as a digital filter with a fixed transfer function is presented and verified through a set of practical experiments. The concept of self-tuning control as a combination of system identification and control is developed within the ANC system framework. Experimental results are presented and compared with those of a system employing a fixed digital filter controller. ESA

N92-18451# International Centre for Theoretical Physics, Trieste (Italy).
THE ROLE OF DISSIPATION IN QUANTUM HALL VOLTAGE PROFILES
A. Cabo and A. Gonzalez Jul. 1991 9 p
(DE92-603736; IC-91/163) Avail: NTIS HC/MF A02

The effects of temperature and Ohmic conduction on the field configurations in IQHE samples are investigated. The dissipative effects are identified as the source of the flowing inside the sample of currents in the experiments. The regimes for the Hall effect observation are traced: the edge current one, working at time intervals shorter than the relaxation time, and the bulk current one related to the stationary state in the presence of dissipation. An approximate analytical solution of the equations describing the steady state is found, which satisfactorily describes the oscillations of the experimental Hall voltage with the magnetic field for interior sample probes, while maintaining the quantization of the Hall resistance. DOE

N92-18466*# Alabama Univ., Huntsville. Dept. of Mechanical Engineering.
FREQUENCY RESPONSE MEASUREMENTS IN BATTERY ELECTRODES Final Report, 1 Feb. - 31 Dec. 1991
Daniel L. Thomas 6 Jan. 1992 32 p
(Contract NAS8-36955)
(NASA-CR-184282; NAS 1.26:184282) Avail: NTIS HC/MF A03 CSCL 09A

Electrical impedance spectroscopy was used to investigate the behavior of porous zinc, silver, cadmium, and nickel electrodes. State of charge could be correlated with impedance data for all but the nickel electrodes. State of health was correlated with impedance data for two AgZn cells, one apparently good and the other bad. The impedance data was fit to equivalent circuit models. Author

N92-18473*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
PLANAR DIELECTRIC RESONATOR STABILIZED HEMT OSCILLATOR INTEGRATED WITH CPW/APERTURE COUPLED PATCH ANTENNA

Rainee N. Simons (Sverdrup Technology, Inc., Brook Park, OH.) and Richard Q. Lee 1992 6 p Proposed for presentation at the 1992 IEEE MTT-S International Microwave Symposium, Albuquerque, NM, 2-4 Jun. 1992
(Contract NAS3-25266)
(NASA-TM-105544; E-6860; NAS 1.15:105544) Avail: NTIS HC/MF A02 CSCL 09A

A new design of an active antenna with a dielectric resonator stabilized high electron mobility transistor (HEMT) oscillator (DRO) and an aperture-coupled patch antenna is reported. The circuit is fabricated using coplanar waveguide (CPW) with the oscillator and the antenna on opposite sides of the substrate. The active antenna was demonstrated at 7.6 GHz; however, the design can be scaled to higher frequencies. Excellent oscillator characteristics and radiation patterns were obtained. Author

N92-18476# Technische Univ., Eindhoven (Netherlands).
THE ZINC SUSPENSION ELECTRODE Ph.D. Thesis
Pieter Jan Sonneveld 1991 152 p Sponsored by Stork Screens B.V. Boxmeer; Netherlands Organization for the Advancement of Pure Research; and Netherlands Agency for Energy and the Environment
(ETN-92-90575) Avail: NTIS HC/MF A08

The development and investigation of a suspension combining charge and discharge in one cell and the investigation of the properties of zinc suspension are addressed. The possibility of a bifunctional use of the current collector is discussed with respect to the material properties and the electrochemical behavior. Zinc nucleation and growth on glassy carbon from an alkaline zincate solution is studied with voltammetric techniques. The conductance of suspensions containing conductive ceramics, graphite, and metal particles in aqueous KOH solutions is measured with the impedance technique using a four electrode cell. The corrosion of zinc suspensions is studied by hydrogen evaluation. Viscosity measurement yields information about the rheological behavior and stability against sedimentation of the suspensions. The effect of suspended particles in the mass transfer at rotating disk electrode is investigated. A model is developed for charge transfer between the current collector and the suspension during the charge and discharge process which shows good agreement with experiment. The results of preliminary cycling experiments with a rotating ring electrode show that the discharge and charge is possible in one cell. With image analysis, an already significant 'net' particle size increase is found during the first six cycles. ESA

N92-18491# National Inst. of Standards and Technology, Gaithersburg, MD. Magnetic Materials Group.
HIGH MAGNETIC FIELD FACILITIES IN JAPAN RELATED TO SUPERCONDUCTIVITY RESEARCH (JAPAN TECHNOLOGY PROGRAM)
Robert D. Shull Aug. 1991 62 p
(PB91-240762; NISTIR-4593) Avail: NTIS HC/MF A04 CSCL 09C

The high magnetic field facilities presently available in Japan and how those facilities are being used for the study of superconducting materials are described. Particular attention is devoted to Japanese technological advances in the development of superconducting materials which may have an impact on the construction of future high magnetic field facilities. Both pulsed magnetic field facilities and constant field generation are evaluated. In addition, future facilities to become available in Japan are listed. GRA

N92-18500# International Centre for Theoretical Physics, Trieste (Italy).
SCALING PROPERTIES OF OPTICAL REFLECTANCE FROM QUASI-PERIODIC SUPERLATTICES
Xiang Wu, Hesheng Yao, and Wei-Guo Feng (Tongji Univ., Shanghai, China) Aug. 1991 12 p
(DE92-603743; IC-91/222) Avail: NTIS HC/MF A03

The scaling properties of the optical reflectance from two types of quasi-periodic metal-insulator superlattices, one with the structure of Cantor bars and the other with the structure of Cantorian-Fibonaccian train, have been studied for the region of s-polarized soft x-rays and extreme ultraviolet. By using the hydrodynamic model of electron dynamics and transfer-matrix method, and by taking into account retardation effects, we have presented the formalism of the reflectivity for the superlattices. From our numerical results, we found that the reflection spectra of the quasi-superlattices have a rich structure of self-similarity. The interesting scaling indices, which are related to the fractal dimensions of the spectra, are also discussed for the two kinds of quasi-superlattices. DOE

N92-18527# Los Alamos National Lab., NM.
THEORY AND MODELING OF A RELATIVISTIC KLYSTRON AMPLIFIER WITH HIGH SPACE CHARGE FOR MICROSECOND APPLICATIONS
B. E. Carlsten, M. V. Fazio, R. J. Faehl, T. J. Kwan, D. G. Rickel, and R. M. Stringfield 1992 28 p Presented at the Society of Photo-Optical Instrumentation Engineers' International Symposium on Laser Spectroscopy as part of SPIE's Symposium on Optics, Electro-optics and Laser Applications in Science and Engineering, Los Angeles, CA
(Contract W-7405-eng-36)
(DE92-004576; LA-UR-91-4150; CONF-920124-1) Avail: NTIS HC/MF A03

We discuss basic Relativistic Klystron Amplifier physics. We show that in the intense space-charge regime, the maximum power extraction does not coincide with the maximum harmonic bunching. In addition, we show that as the beam is bunched, the additional power stored in the Coulomb fields does not add significantly to the overall power extraction. Because of these effects, the power extraction at 1.3 GHz for a 500 kV, 5 kA beam with reasonable beam-to-wall spacing is limited to around 35 percent. DOE

N92-18546# California Univ., Berkeley. Lawrence Berkeley Lab.
METHOD FOR ELIMINATING ARTIFACTS IN CCD IMAGERS Patent Application
B. T. Turko, inventor (to DOE) and G. J. Yates, inventor (to DOE) 29 Jun. 1990 25 p Prepared in cooperation with Lawrence Livermore National Lab., CA
(Contracts DE-AC03-76SF-00098; W-7405-eng-48)
(DE92-003816; US-Patent-Appl-SN-545732;
Patents-US-A7545732) Avail: NTIS HC/MF A03

An electronic method for eliminating artifacts in a video camera employing a charge coupled device (CCD) as an image sensor is presented. The method comprises the step of initializing the camera prior to normal readout. The method includes a first dump cycle period for transferring radiation generated charge into the horizontal register. This occurs while the decaying image on the phosphor being imaged is being integrated in the photosites, and a second dump cycle period, occurring after the phosphor image has decayed, for rapidly dumping unwanted smear charge which has been generated in the vertical registers. Image charge is then transferred from the photosites and to the vertical registers and readout in conventional fashion. The inventive method allows the video camera to be used in environments having high ionizing radiation content, and to capture images of events of very short duration and occurring either within or outside the normal visual wavelength spectrum. Resultant images are free from ghost, smear, and smear phenomena caused by insufficient opacity of the registers, and are also free from random damage caused by ionization charges which exceed the charge limit capacity of the photosites. DOE

N92-18550# Oak Ridge National Lab., TN.
COUNTERROTATING BRUSHLESS DC PERMANENT MAGNET MOTOR Patent Application
R. A. Hawsey, inventor (to DOE) and J. M. Bailey, inventor (to DOE) 30 Jul. 1990 13 p
(Contract DE-AC05-84OR-21400)
(DE92-003825; US-Patent-Appl-SN-559030;
Patents-US-A7559030) Avail: NTIS HC/MF A03

A brushless DC permanent magnet motor is provided for driving

an autonomous underwater vehicle. In one embodiment, the motor comprises four substantially flat stators disposed in stacked relationship, with pairs of the stators being axially spaced and each of the stators comprising a tape-wound stator coil; first and second substantially flat rotors disposed between the spaced pairs of stators. Each of the rotors includes an annular array of embedded permanent magnets. A first shaft is connected to the first rotor and a second, concentric shaft is connected to the second rotor, and the drive unit causes rotation of the two shafts in opposite directions. The second shaft comprises a hollow tube having a central bore in which the first shaft is disposed. Two different sets of bearings support the first and second shafts. In another embodiment, the motor comprises two ironless stators and pairs, and rotors mounted on opposite sides of the stators and driven by counterrotating shafts. DOE

N92-18559# Sandia National Labs., Albuquerque, NM.
ACCELERATED TESTING OF BATTERIES
S. C. Levy and P. Bro 1992 8 p Presented at the 7th Annual Battery Conference on Applications, Long Beach, CA, 21-23 Jan. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004739; SAND-91-2529C; CONF-920151-1) Avail: NTIS HC/MF A02

Three methods of evaluating accelerated battery test data are described. Criteria for each method are used to determine the minimum test matrix required for accurate predictions. Other test methods involving high current discharge and real-time techniques are discussed. DOE

N92-18677# International Centre for Theoretical Physics, Trieste (Italy).
THERMOELECTRIC POWER AND TOPOLOGICAL TRANSITIONS IN QUASI-TWO-DIMENSIONAL ELECTRONIC SYSTEMS
Ya. M. Blanter, A. V. Pantsulaya, and A. A. Varlamov May 1991 22 p
(DE92-603808; IC-91/54) Avail: NTIS HC/MF A03

Electron-impurity relaxation time and the thermoelectric power (TEP) of quasi-2-D electron gas are calculated. Two cases are discussed: the isotropic spectrum and the electronic topological transition (ETT) of the 'neck breaking' type. Methods of thermal diagramatic technique are used for the calculation. It is found that the TEP in the vicinity of the ETT greatly exceeds its background value. The results of experimental investigations of the TEP in the' metal oxide semiconductor' structures are compared with the predictions of the proposed theory. DOE

N92-18689# Sandia National Labs., Albuquerque, NM.
METHOD OF MAKING SEMICONDUCTOR JUNCTIONS Patent Application
R. B. James, inventor (to DOE) 13 Jun. 1990 28 p
(Contract DE-AC04-76DR-00789)
(DE92-003686; US-Patent-Appl-SN-537957;
Patents-US-A7537957) Avail: NTIS HC/MF A03

A p-n junction on a silicon substrate doped with boron ions (d-dopant) is made in the following manner. A shallow silicon surface layer including a n-type dopant is first obtained by ion implantation of the substrate with arsenic atoms. The arsenic-doped silicon layer at the surface has a relatively low initial reflectivity. Then, radiation from a pulsed carbon dioxide laser is directed onto the doped surface. A portion of the pulsed radiation causes melting of the thin arsenic-doped layer at the solid surface, giving the shallow melted surface a reflectivity greater than the initial reflectivity of the solid surface. The increased reflectivity of the melted surface prevents an additional portion of the pulsed radiation from causing further melting, thus controlling the depth of melting. The melted surface is then allowed to cool and solidify to form a p-n junction at a thin (less than 200A) junction depth. DOE

N92-18690# Lawrence Livermore National Lab., CA.
ELECTRICAL GROUNDING PRONG SOCKET Patent Application
R. Leong, inventor (to DOE) 31 May 1990 29 p
(Contract W-7405-eng-48)
(DE92-003740; US-Patent-Appl-SN-531437;
Patents-US-A7531437) Avail: NTIS HC/MF A03

The invention is a socket for a grounding prong used in a three prong electrical plug and a receptacle for the three prong plug. The socket being sufficiently spacious to prevent the socket from significantly stretching when a larger, U-shaped grounding prong is inserted into the socket, and having a ridge to allow a snug fit when a smaller tubular shape grounding prong is inserted into the socket. DOE

N92-18691# Oak Ridge National Lab., TN.
WEDGE ASSEMBLY FOR ELECTRICAL TRANSFORMER COMPONENT SPACING Patent Application
F. E. Baggett, inventor (to DOE) and W. F. Cage, inventor (to DOE) 4 Jun. 1990 12 p
(Contract DE-AC05-84OR-21400)
(DE92-003742; US-Patent-Appl-SN-532545;
Patents-US-A7532545) Avail: NTIS HC/MF A03

This invention is comprised of a wedge assembly that is easily inserted between two surface to be supported thereby, and thereafter expanded to produce a selected spacing between those surfaces. This wedge assembly has two outer members that are substantially identical except that they are mirror images of each other. Oppositely directed faces of these of these outer members are substantially parallel for the purpose of contacting the surfaces to be separated. The other faces of these outer members that are directed toward each other are tapered so as to contact a center member having complementary tapers on both faces. A washer member is provided to contact a common end of the outer members, and a bolt member penetrates this washer and is threadably received in a receptor of the center member. As the bolt member is threaded into the center member, the center member is drawn further into the gap between the outer members and thereby separates these outer members to contact the surfaces to be separated. In the preferred embodiment, the contacting surfaces of the outer member and the center member are provided with guide elements. The wedge assembly is described for use in separating the secondary windings from the laminations of an electrical power transformer. DOE

N92-18717# Helsinki Univ. of Technology, Otaniemi (Finland). Lab. of Thermal Engineering.
MANUFACTURE OF AIR ELECTRODES AND LONG RUN TESTS
J. Lamminen, M. J. Lampinen, M. Viitanen, J. Vuorisalo, and J. Kivisaari (Royal Inst. of Tech., Stockholm, Sweden) 1990 11 p
(DE92-728394; TKK-KO/LTK-44) Avail: NTIS HC/MF A03

In this study some alternative catalysts for oxygen reduction in an alkaline electrolyte (7 M KOH) were tested. The catalysts tested were: CoTMPP, LaNiO3, Pt (for comparison) and MnO2. The electrodes were manufactured by the rolling method. The best electrodes made in this way has been tested in a long run test, testing times ranging from 425 hours to 660 hours. The decay in potential during the 660 hour run was 0.041 mV/h. DOE

N92-18719# Argonne National Lab., IL.
FLUX MOTION AND DISSIPATION IN HIGH-TEMPERATURE SUPERCONDUCTORS
K. E. Gray and D. H. Kim Aug. 1991 5 p Presented at the Phenomenology and Applications of High Temperature Superconductivity, Los Alamos, NM, 22-24 Aug. 1991
(Contract W-31-109-eng-38)
(DE92-004141; ANL/CP-74692; CONF-9108140-2) Avail: NTIS HC/MF A01

The effects on flux motion and dissipation of interlayer coupling of the Cu-O planes along the c-axis are considered for the high temperature superconductors (HTS). It is argued that for the highly anisotropic HTS, the weak interlayer coupling plays a dominant role that can be described by incoherent Josephson tunneling between superconducting Cu-O bi- or tri-layers. In YBa2Cu3O7

the layers are strongly coupled, presumably because the conducting Cu-O chains short circuit the Josephson tunneling, so that these effects are weak or missing. DOE

N92-18735# Oak Ridge National Lab., TN.
SURVEY OF DOMESTIC RESEARCH ON SUPERCONDUCTING MAGNETIC ENERGY STORAGE
L. Dresner Sep. 1991 31 p
(Contract DE-AC05-84OR-21400)
(DE92-004108; ORNL/HTSPC-1) Avail: NTIS HC/MF A03

This report documents the results of a survey of domestic research on superconducting magnetic energy storage (SMES) undertaken with the support of the Oak Ridge National Laboratory (ORNL) Superconductivity Pilot Center. Each survey entry includes the following: Name, address, and other telephone and facsimile numbers of the principal investigator and other staff members; funding for fiscal year 1991, 1992, 1993; brief descriptions of the program, the technical progress to date, and the expected technical progress; a note on any other collaboration. Included with the survey are recommendations intended to help DOE decide how best to support SMES research and development (R&D). To summarize, I would say that important elements of a well-rounded SMES research program for DOE are as follows: (1) Construction of a large ETM. (2) Development of SMES as an enabling technology for solar and wind generation, especially in conjunction with the ETM program, if possible. (3) Development of small SMES units for electric networks, for rapid transit, and as noninterruptible power supplies (uses (2), (3), and (4) above). In this connection, lightweight, fiber-reinforced polymer structures, which would be especially advantageous for space and transportation applications, should be developed. (4) Continued study of the potential impacts of high-temperature superconductors on SMES, with construction as soon as feasible of small SMES units using high-temperature superconductors. DOE

N92-18743# California Univ., Berkeley. Lawrence Berkeley Lab.
NOISE IN a-Si:H p-i-n DETECTOR DIODES
G. Cho, S. Qureshi, J. S. Drewery, T. Jing, S. N. Kaplan, H. Lee, A. Mireshghi, V. Perez-Mendez, and D. Wildermuth Oct. 1991 6 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004172; LBL-31415; CONF-911106-42) Avail: NTIS HC/MF A02

Noise of a-Si:H p-i-n diodes (5 to approx. 50 microns thick) under reverse bias was investigated. The current dependent 1/f type noise was found to be the main noise component at high bias. At low bias, the thermal noise from a series resistance of the p-layer and of the metallic contacts is the dominant noise source which is unrelated to the reverse current through the diode. The noise associated with the p-layer resistance decreased significantly on annealing under reverse bias, reducing the total zero bias noise by a factor 2 approximately. The noise recovered to the original value on subsequent annealing without bias. In addition to the resistive noise, there seems to be a shaping time independent noise component at zero biased diodes. DOE

N92-18748# Sandia National Labs., Albuquerque, NM.
UTILITY BATTERY EXPLORATORY TECHNOLOGY DEVELOPMENT PROGRAM REPORT FOR FY91
N. J. Magnani, P. C. Butler, A. A. Akhil, J. W. Braithwaite, N. H. Clark, and J. M. Freese Dec. 1991 117 p
(Contract DE-AC04-76DP-00789)
(DE92-004854; SAND-91-2694) Avail: NTIS HC/MF A06

Sandia National Laboratories, Albuquerque, manages the Utility Battery Exploratory Technology Development Program, which is sponsored by the U.S. Department of Energy's Office of Energy Management. In this capacity, Sandia is responsible for the engineering analyses and development of rechargeable batteries for utility-energy-storage applications. This report details the technical achievements realized during fiscal year 1991. Sodium/Sulfur, Zinc/Bromine, Nickel/Hydrogen, Aluminium/Air, and Lead/Acid batteries are evaluated. DOE

N92-18769# General Electric Co., Schenectady, NY.
NUCLEAR QUALIFIED IN-CONTAINMENT ELECTRICAL CONNECTORS AND METHODS OF CONNECTING ELECTRICAL CONDUCTORS Patent Application
J. G. Powell, inventor (to DOE) 9 Jul. 1990 12 p
(Contract DE-AC12-76SN-00052)
(DE92-003820; US-Patent-Appl-SN-549982; Patents-US-A7549982) Avail: NTIS HC/MF A03

A nuclear qualified in-containment electrical connection is presented that comprises: (1) an insulated, sheathed instrument lead having electrical conductors extending from one end thereof to provide two exposed lead wires; (2) a watertight cable having electrical conducting wires therein and extending from one end of the cable to provide two lead wires therefrom; (3) two butt splice connectors each connecting the ends of respective ones of the lead wires from the instrument lead and cable; (4) a length of heat shrinkable plastic tubing positioned over each butt splice connector and an adjacent portion of a respective lead wire from the cable and heat shrunk into position; and (5) a length of heat shrinkable plastic tubing on the end portion of the instrument lead adjacent the lead wires therefrom, heat shrunk thereon, with a length of outer heat shrinkable plastic tubing. The plastic tubing extends over the end portion of the instrument lead and the heat shrinkable tubing and over the butt splice connectors and a portion of the cable adjacent the cable lead lines. The outer heat shrinkable tubing is heat shrunk into sealing position on the instrument lead and cable. DOE

N92-18802# Lawrence Livermore National Lab., CA.
GENERATION OF HIGH-QUALITY PETAWATT PULSES
G. Mourou and Philippe Bado (Michigan Univ., Ann Arbor.) 1991 28 p
(Contract W-7405-eng-48)
(DE92-003965; UCRL-CR-108460) Avail: NTIS HC/MF A03

Chirped Pulse Amplification (CPA) sources need a front-end capable of generating very short seed pulses. To meet this requirement, present CPA sources rely on actively modelocked solid-state oscillators used in conjunction with non-linear fiber stages. This approach generates pulses with a residual frequency chirp, resulting in a limited peak-to-background intensity contrast ratio. The availability of an oscillator capable of producing directly (i.e., without fiber stage) picosecond or sub-picosecond pulses would significantly improve the quality of CPA sources. We have pursued different approaches to replace the standard modelocked oscillator front-end. In an initial phase, we investigated the possible use of Additive Pulse Modelocking (APM) color-center lasers as oscillators for CPA Nd:glass sources. Lately we have developed a Ti:Sapphire modelocked oscillator operating in the one-micron range. In order to generate pulses with very high peak to background contrast ratio, we have built a non-linear coupled-cavity oscillator generating 200-fs pulses. This color-center laser operates in the 1.5-1.6 micron range. The laser is pumped with a modelocked Nd:YAG source. Both KCl and NaCl crystals were tested as gain media. NaCl was found to have a larger tuning range and to generate a higher average power (up to 150 mW). When synchronously mode-locked, the color-center generates pulses in the 10-20 ps range. Once interferometrically coupled to non-linear external-cavity, this oscillator produces very short pulses (85 to 260 fs). This oscillator was first operated with a 2 mm birefringent plate. Also, 85 fs, near transform-limited pulses were generated at 1.54 micron. As the laser was tuned to longer wavelength, the pulse duration increased, as well as the bandwidth-duration product. With a 4 mm birefringent plate, 125 fs, transform-limited pulses were generated over the full tuning range. DOE

N92-18819# Texas Technological Univ., Lubbock. Dept. of Electrical Engineering.
INVESTIGATION OF A PLASMA EDGE CATHODE UNDER HIGH CURRENT DENSITY ELECTRON EXTRACTION Final Technical Report, 1 Apr. 1987 - 30 Sep. 1991

Klaus W. Zieher 5 Dec. 1991 39 p
(Grant AF-AFOSR-0154-87)
(AD-A244290; AFOSR-91-1025TR) Avail: NTIS HC/MF A03
CSCL 09/1

A scheme with the potential for generation of an electron beam with high brightness and several microsec pulse duration for microwave generation, electron accelerators, or free electron lasers has been investigated experimentally. An electron beam was extracted transversely to the flow of a plasma jet. The transverse boundary of the plasma allowed extraction of a space charge limited electron current for 7 microsec at a current density of 18 A/sq cm. A normalized microscopic brightness of 8 x 10 exp 8 Am(exp -2)rad(exp -2) was achieved. Closure of the extraction gap by invasion of plasma has been observed with a velocity as low as 0.1 cm/microsec. Higher current density and higher brightness is expected for higher plasma densities and larger extraction fields. Numerical simulation using the MAGIC code confirmed the expected features of the scheme. GRA

N92-18868# Syracuse Univ., NY. Dept. of Electrical and Computer Engineering.
FULL-WAVE ANALYSIS OF MICROWAVE INTEGRATED CIRCUITS USING THE SURFACE INTEGRAL FORMULATION Final Report
Roger F. Harrington 10 Dec. 1991 7 p
(Contract DAAL03-88-K-0133)
(AD-A244385; ARO-25422.13-EL) Avail: NTIS HC/MF A02
CSCL 09/1

This contract studied 5 principal topics: (1) full wave analysis of microstrip crossovers; (2) dynamic and quasi-dynamic analysis of printed circuits; (3) user-friendly computer programs for multiconductor transmission lines; (4) theory of printed circuits for multilayered dielectrics; and (5) full-wave analysis of transmission lines in a layered uniaxial medium. Author (GRA)

N92-18882# California Univ., Berkeley. Coll. of Engineering.
HIGH-FREQUENCY SIGNAL-PROCESSING INTEGRATED CIRCUITS Final Report, 20 May 1987 - 19 May 1991
R. G. Meyer and D. O. Pederson 26 Aug. 1991 9 p
(Contract DAAL03-87-K-0079)
(AD-A244410; ARO-24890.8-EL) Avail: NTIS HC/MF A02
CSCL 09/1

A new topology for maximum-bandwidth matched-impedance monolithic amplifiers has been synthesized, fabricated, and tested. Stage gain of 9.3 dB and bandwidth of 3.2 GHz were realized in a 9 GHz Si bipolar monolithic technology. A new variable-gain amplifier with maximum dynamic range has been devised, fabricated, and tested. This achieved 850 MHz bandwidth, 30 dB gain control range, and 25 dB maximum gain. Equivalent input noise resistance was 400 Ohm. The successful fabrication of on-chip inductors in Si monolithic circuits was demonstrated, with application to passive filters and bandpass amplifiers in the GHz frequency range. New high-performance monolithic voltage-controlled-oscillators and phase-locked loops were synthesized, built, and tested to verify new design procedures. GRA

N92-18904# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
REQUIREMENTS ANALYSIS FOR A HARDWARE, DISCRETE-EVENT, SIMULATION ENGINE ACCELERATOR M.S. Thesis
Paul J. Taylor, Jr. Dec. 1991 183 p
(AD-A244202; AFIT/GCE/ENG/91D-11) Avail: NTIS HC/MF A09 CSCL 12/5

An analysis of a general Discrete Event Simulation (DES), executing on the distributed architecture of an eight mode Intel PSC/2 hypercube, was performed. The most time consuming portions of the general DES algorithm were determined to be the functions associated with message passing of required simulation data between processing nodes of the hypercube architecture. A behavioral description, using the IEEE standard VHSIC Hardware Description and Design Language (VHDL), for a general DES hardware accelerator is presented. The behavioral description specifies the operational requirements for a DES coprocessor to augment the hypercube's execution of DES simulations. The DES coprocessor design implements the functions necessary to perform distributed discrete event simulations using a conservative time synchronization protocol. GRA

N92-18916# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
SLIDING MODE CONTROL: APPLICATION TO ELECTRICAL CONVERTERS Ph.D. Thesis - Toulouse Univ. [COMMANDE PAR MODE DE GLISSEMENT: APPLICATION AUX CONVERTISSEURS ELECTRIQUES]
Fares Boudjema 1991 126 p In FRENCH; ENGLISH summary
(LAAS-91170; ETN-92-90666) Avail: NTIS HC/MF A07

Robust control synthesis of electrical converters using the principal of a sliding mode is studied. As electrical converters are naturally variable structure systems, the sliding control technique is well adapted for control purposes. This type of control is developed for an inverter obtained from a fourth quadrant buck converter. Simulation and experimental results coincide with those predicted theoretically. An extended application of sliding mode control theory is obtained with a series of resonant converters. Such converters present a nonlinear characteristic. Simulation results are presented which highlight the advantages of variable structure systems theory to resonant converters. ESA

N92-18920*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
STATUS AND FUTURE DIRECTIONS OF InP SOLAR CELL RESEARCH
R. K. Jain and I. Weinberg 1992 8 p Presented at the 6th International Photovoltaic Science and Engineering Conference, New Delhi, India, 10-14 Feb. 1992; sponsored by Dept. of Non-Conventional Energy Sources, Government of India, Solar Energy Society of India, and Nat'l. Physical Lab.
(NASA-TM-105426; E-6738; NAS 1.15:105426) Avail: NTIS HC/MF A02 CSCL 10B

An overview of the current status and future directions of InP space solar cell research is provided. The scope of the paper does not allow us to discuss other recent major developments in InP cell modeling, contacts, and characterization, or developments in other solar cell materials. Solar cells made from InP and related materials are not expected to be used in the near future for terrestrial applications, but significant Air-Mass1.5 (AM1.5) cell efficiencies are given for comparison. This paper deals with the developments in single-junction cells, multijunction tandem cells, and space flight testing, including radiation effects. Concentrator InP solar cells are also discussed, since they offer the possibility of simultaneous thermal and current injection annealing. These cells also promise cost effectiveness and the concentrator elements may provide cells with extra protection from space radiation. The concluding section addresses the steps to be taken in the future and provides guidelines for further research and development. Author

N92-18935# Mission Research Corp., Albuquerque, NM.
RADIATION EFFECTS TEST CHIP GUIDELINES Final Report, 28 Feb. 1987 - 8 Feb. 1991
David R. Alexander Nov. 1991 195 p
(Contract DAAL02-86-D-0043)
(AD-A243813; MRC/ABQ-R-1288; HDL-CR-91-043-1) Avail: NTIS HC/MF A09 CSCL 20/12

Test chips and special test structures are assuming a role of ever increasing importance in the development of radiation-hardened microcircuits. The reason for this expanding role lies in the expense and complexity of VHSIC (very high speed integrated circuits) and VLSIC (very large scale integrated circuits) class microcircuits. Special devices are required to (1) investigate failure mechanisms, (2) evaluate process hardness, (3) develop design rules, and (4) provide for hardness assurance monitoring. The purpose of this document is to provide information on a variety

of devices which have been found useful in developing radiation-hardened microcircuits for metal oxide semiconductor (epi/bulk, SOS, and SOI) and bipolar technologies. GRA

N92-18630# MATRA Espace, Toulouse (France).
SYSTEMS SAFETY: PRACTICAL EVALUATION OF SNEAK CIRCUIT ANALYSIS APPLIED TO CASE STUDIES
P. Charon, J. M. Jeandupeux, A. LeHenaff, J. Mignot, and O. Nicolas (CEP Systemes, Toulouse, France) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 141-145 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18631# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands). Product Assurance and Safety Dept.
ESA RESEARCH AND DEVELOPMENT STRATEGY ON SNEAK ANALYSIS
B. Dore *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 147-152 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

34 FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling.

For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

N92-18046# Manchester Univ. (England). Aeronautical Engineering Group.
A FINITE DIFFERENCE METHOD FOR MODELLING INTERNAL WAVES
R. Liu and T. N. Stevenson 1989 36 p
(Aero-Rept-8908; ETN-92-90915) Avail: NTIS HC/MF A03

A modified Marker And Cell (MAC) method for studying internal waves in incompressible stably stratified fluids is described. Open boundary conditions are used. The method is compared with the analytical viscous similarity solution for internal cross waves as a check of the open boundary conditions. The arms of the cross wave are found to be slightly steeper than suggested by theory. This was previously observed experimentally. The finite difference solution shows the upstream and downstream wakes which are absent in the analytical approach. ESA

N92-18047# Manchester Univ. (England). Aeronautical Engineering Group.
WAVES FROM AN OSCILLATORY DISTURBANCE IN A STRATIFIED SHEAR FLOW
R. Liu, D. Nicolau, and T. N. Stevenson 1989 24 p Sponsored by Admiralty Research Establishment
(Aero-Rept-8910; ETN-92-90916) Avail: NTIS HC/MF A03

The modification of the St Andrew's cross wave in a density stratified fluid by the horizontal shear above the level of the source is shown. Ray theory is used to develop the equations for the phase configuration and for the special case when the background natural frequency is constant and the shear is linear, the wave crests are shown to be straight lines passing through the source. The waves corresponding to outgoing energy have phase velocities directed towards the horizontal level of the source and the waves which have undergone a reflection have phase velocities directed towards the vertical. The ray theory predictions are shown to compare well with experiment and with finite difference calculations. ESA

N92-18075# Minnesota Univ., Minneapolis. Inst. for Mathematics and its Applications.
PHASE TRANSITIONS AND FREE BOUNDARIES Final Report
Willard Miller, Jr. 31 Oct. 1991 17 p
(Contract N00014-91-J-1059)
(AD-A243412) Avail: NTIS HC/MF A03 CSCL 09/1

Viscous flows interact with liquid/fluid interfaces and solidification fronts in a wide variety of technologies including the processing of coatings, polymers, semiconductors single crystals, and other advanced materials. This workshop addresses the mathematical treatment of the dynamical and instability phenomena in such flows. Special topics include solidification with flows, wetting lines, and the instabilities of drops and films. Presentations will focus on the development of asymptotic and numerical strategies for solution of these problems. Macroscopic models of superconductivity and their relationship to free boundary problems are discussed. GRA

N92-18077# California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
MIXING IN HIGH SCHMIDT NUMBER TURBULENT JETS Ph.D. Thesis
Paul L. Miller 1991 143 p
(Grant AF-AFOSR-0304-90; AF Proj. 2308)
(AD-A243416; AFOSR-91-0894TR) Avail: NTIS HC/MF A07 CSCL 20/4

This thesis is an experimental investigation of the passive scalar (species concentration) field in the far-field of round, axisymmetric, high Schmidt number (liquid phase), turbulent jets issuing into a quiescent reservoir, by means of a quantitative laser-induced fluorescence technique. Single-point concentration measurements are made on the jet centerline, at axial locations from 100 to 305 nozzle diameters downstream, and Reynolds numbers of 3,000 to 102,000, yielding data with a resolved temporal dynamic range up to 2.5 x 10(exp 5), and capturing as many as 504 large-scale structure passages. Long-time statistics of the jet concentration are found to converge slowly. Between 100 and 300 large-scale structure passages are required to reduce the uncertainty in the mean to 1 percent, or so. The behavior of the jet varies with Reynolds (Re) number. The centerline concentration pdf's become taller and narrower with increasing Re, and the normalized concentration variances correspondingly decrease with Re. The concentration power spectra also evolve with Re. The behavior of the spectral slopes is examined. No constant -1 (Batchelor) spectral slope range is present. Rather, in the viscous region, the power spectra exhibit log-normal behavior, over a range of scales exceeding a factor of 40, in some cases. GRA

N92-18088# Manchester Univ. (England). Aeronautical Engineering Group.
A SURVEY OF THE NUMERICAL SIMULATION OF UNSTEADY FLOWS PAST CAVITIES (WITH AERODYNAMIC APPLICATIONS)
D. R. Emerson and D. I. A. Poll 1990 36 p
(Contract MOD-2052/78/RAE(F))
(Aero-Rept-9002; ETN-92-90919) Avail: NTIS HC/MF A03

A survey of the numerical modeling of cavity flows (with aerodynamic applications) was undertaken. All the modern methods are shown to have been able to capture the important features. In general, the agreement between simulation and experiment is qualitative although, for some L/D ratios and free stream Mach numbers, good quantitative agreement has been achieved. When discrete frequencies are present, the predicted sound pressure levels typically lie within 2 to 10 dB of the experimental values. The higher harmonics are generally smoothed out due to the necessary presence of artificial viscosity to stabilize the computational scheme. The most popular numerical method is found to be that suggested by MacCormack. ESA

N92-18099# Maryland Univ., College Park.
LAGRANGIAN ANALYSIS OF CONTAMINANT DISPERSAL IN BOUNDED TURBULENT SHEAR FLOWS
P. S. Bernard, J. M. Wallace, and J. L. Balint 1991 10 p
(Contract DE-FG05-88ER-13838)
(DE92-003671; DOE/ER-13838/4) Avail: NTIS HC/MF A02

Methods of solving Navier-Stokes equations for turbulent

channel flow are given. These numerical solutions utilize either Neumann or Dirichlet boundary conditions. Computer codes were written and tested and are discussed. Digital image processing of flow visualization video sequences, taken simultaneously with vorticity probe measurements in a turbulent boundary layer, were carried out. DOE

N92-18105# Lawrence Livermore National Lab., CA.
NUMERICAL SIMULATION OF ACCELERATED INTERFACES
D. L. Marcus, J. B. Bell, E. G. Puckett, and J. Saltzman (Los Alamos National Lab., NM.) 21 Oct. 1991 15 p Presented at the Workshop on Physics of Compressible, Turbulent Mixing, Royaumont, France, 17-19 Jun. 1991
(Contract W-7405-eng-48)
(DE92-004670; UCRL-JC-10872; CONF-9106222-10) Avail: NTIS HC/MF A03

We describe two numerical methods that have been designed to model the dynamics of accelerated interfaces. One method is based on the numerical approximation of the incompressible, variable-density Navier-Stokes equations while the other is based on a numerical approximation of the Euler equations. One feature that these methods share is that the numerical approximation to the governing fluid flow equations is accomplished in part by means of a second order extension of Godunov's method. We present the results of computations to model Rayleigh-Taylor instability and Richtmyer-Meshkov instability. DOE

N92-18116# Wichita State Univ., KS. National Inst. for Aviation Research.
EXAMINATION OF ENERGY SPECTRA MOMENTS IN A DEVELOPING TURBULENT FLOW
Julie A. Mathis Dec. 1991 20 p
(NIAR-91-28) Avail: NTIS HC/MF A03

Velocity measurements are made in a turbulent developing flow. The experiment is performed in a wind tunnel and consists of a jet ejecting normally into a confined cross stream. Measurements are made by laser velocimetry, with the data sampled and recorded at a high enough rate to allow characterizations of the turbulent fine scales (38,000 sec(exp -1)). Kolmogorov-normalized energy spectra and their moments are constructed, and examined for micro-scale Reynolds number dependence. The data reveals a very well correlated logarithmic relationship between the peak values of moments of the normalized energy spectra and the microstructure Reynolds number. Author

N92-18190*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
HELIUM JET DISPERSION TO ATMOSPHERE
Hasna J. Khan 1986 66 p
(Grant NAG5-1121)
(NASA-CR-189885; NAS 1.26:189885) Avail: NTIS HC/MF A04 CSCL 20D

On the event of loss of vacuum guard of superinsulated helium dewar, high rate of heat transfer into the tank occurs. The rapid boiling of liquid helium causes the burst disk to rupture at four atmospheres and consequently the helium passes to the atmosphere through vent lines. The gaseous helium forms a vertical buoyant jet as it exits the vent line into a stagnant environment. Characterization of the gaseous jet is achieved by detailed analysis of the axial and radial dependence of the flow parameters. Author

N92-18200# Manchester Univ. (England). Aeronautical Engineering Group.
MODELLING OF INTERFACIAL AND THERMOCLINE WAVES Report No. 1
F. A. Paonessa 3 Jan. 1990 24 p
(Contract MOD-2052/88/Space(88))
(Aero-Rept-9003; ETN-92-90920) Avail: NTIS HC/MF A03

The towing tank design and a general overview of work to date are given. The potentials of ray theory and plan view theory to theoretical analysis of phase configuration of internal waves from a body moving in a thermocline are compared. Extending the ray theory approach to three dimensions involves a considerable amount of algebra but is necessary to make a direct comparison between the phase configurations predicted by ray theory and the plan view theory. More detailed analysis needs to be made on the effects of having the two different dispersion relations in the theories and to what extent the difference in the results can be predicted. The plan view theory needs to be extended so that it is not restricted to bodies traveling along the center of the thermocline though the method of achieving this and the amount of work involved has yet to be considered. ESA

N92-18213# Sheffield Univ. (England). Dept. of Control Engineering.
TOWARDS AN IMPROVED WAVE FORCE EQUATION
K. Worden, P. K. Stansby, G. R. Tomlinson (Manchester Univ., England), and S. A. Billings Mar. 1991 21 p Presented at 1st 1991 International Offshore and Polar Engineering Conference, Edinburgh, Scotland, 11-16 Aug. 1991 Sponsored by DOE (UK)
(RR-423; ETN-92-90645) Avail: NTIS HC/MF A03

An extension of the Morison equation is proposed to improve wave force prediction. A comparion is made between the performance of Morison's equation and the extended model in curve fitting to measured time data. Both regular oscillatory flows in a U tube and irregular oscillatory flows in a wave plume are considered. It is concluded that stability or bifurcation problems prevent the accurate prediction of wave force data from velocities. Improvement in the curve fits to the data indicate that the structures would be of value if the stability problems could be overcome. ESA

N92-18221# National Aerospace Lab., Amsterdam (Netherlands). Fluids Div.
CAR 88: A METHOD TO CALCULATE SUBSONIC AND SUPERSONIC, STEADY AND UNSTEADY, POTENTIAL FLOW ABOUT COMPLEX CONFIGURATIONS
M. H. L. Hounjet 7 Oct. 1988 75 p Sponsored in part by Royal Netherlands Air Force
(NLR-TR-88154-U; ETN-92-90956) Avail: NTIS HC/MF A04

A description of the method CAR88 for the calculation of steady and time linearized unsteady subsonic and supersonic flow about complex two dimensional and three dimensional configurations is given. The method belongs to the category of the so called panel methods. Results of applications in supersonic flow made to a two dimensional oscillating flat plate, a two dimensional double and single edge airfoil, three dimensional cones, and to single and multiple interfering wing surface are shown. ESA

N92-18222# Washington Univ., Seattle. Dept. of Applied Mathematics.
INITIAL-VALUE PROBLEMS AND STABILITY IN SHEAR FLOWS
W. O. Criminale Oct. 1991 21 p
(Contract DE-FG06-88ER-25061)
(DE92-004391; DOE/ER-25061/T1; TR-91-13) Avail: NTIS HC/MF A03

It is the plan of this presentation to outline three major topics of the novel analysis: (1) use of exact solutions in solving initial-value problems; (2) a detailed linear example that illustrates the relevance of the early period and possible instability; and (3) Lagrangian mechanics and the link to computational fluid dynamics. DOE

N92-18235# Manchester Univ. (England). Aeronautical Engineering Group.
COMPUTATION OF LAMINAR FLOW OVER CAVITIES Ph.D. Thesis Final Report
D. R. Emerson and D. I. A. Poll 1990 296 p
(Contract MOD-2052/78/RAE(F))
(Aero-Rept-9013; ETN-90929) Avail: NTIS HC/MF A13

A survey of the numerical simulation of cavity flows with aerodynamic applications is presented. Based on this information, a MacCormack TVD scheme was developed to solve the Navier-Stokes equations for laminar flow. The computations

indicate that the oscillatory frequencies are essentially independent of wall temperature T(sub W), stagnation temperature T(sub 0), boundary layer thickness at separation delta(sub s) and unit Reynolds number. However, the magnitude of the pressure fluctuations depends strongly on T(sub w) and delta(sub s). High wall to edge temperature ratios produce a damping of the oscillations, with a corresponding decrease in drag. For supersonic flow below Mach 2, a fundamental frequency is produced which is consistent with the predictions of existing semiempirical methods, and which corresponds to a second mode of oscillation. Higher frequencies are found and these are harmonics of the fundamental frequency. For Mach numbers between 2 and 2.5, subharmonics are also present. At Mach 2.5, a first mode occurs which is also consistent with semiempirical methods. Higher frequencies also occur but they are not harmonics. The computations also indicate that thick boundary layers will damp the oscillations and reduce drag. ESA

N92-18236# Manchester Univ. (England). Aeronautical Engineering Group.

THE LAMINAR NATURAL CONVECTION ON A HORIZONTAL SURFACE M.S. Thesis

Yvonne Owen Oct. 1990 30 p Sponsored by Science Research Council

(Aero-Rept-9015; ETN-92-90930) Avail: NTIS HC/MF A03

Laminar natural convection flows which develop from a circular cut out on a heated horizontal surface of an infinite expanse are discussed. The first order boundary layer analysis includes variable properties effects and is studied in detail for both air and water flows. The boundary layer development which forms both close to the circular cut out, and at a long distance from this leading edge are studied throughly. Detailed calculations and results are presented for both cases. The equivalent boundary layer problem of the given surface cooled and facing downwards were also studied. Results in this case are given for water flow. ESA

N92-18244# Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Goettingen (Germany, F.R.).

INSTITUTE FOR EXPERIMENTAL FLUID MECHANICS: RESULTS FOR 1990 [INSTITUT FUER EXPERIMENTELLE STROEMUNGSMECHANIK ERGEBNISSE 1990]

T. Green-Thomas Jul. 1991 152 p In GERMAN

(IB-222-90-A-46) Avail: NTIS HC/MF A08

Summaries are presented for areas of research at the Institute. The departments represented include the Dept. of Measurement Physics, Dept. of Boundary Layer and Subsonic Flow, Dept. of Lattice Flow, Dept. of High Speed Flow, and the Dept. of Rarefied and Real Gas Flow. Some of the programs are as follows: commercial aircraft technologies; military aircraft and aircraft structures technology; turbine aircraft engine technologies; simulations and design fundamentals; hypersonic and reentry technologies; and orbital technologies. E.R.

N92-18291# Manchester Univ. (England). Aeronautical Engineering Group.

THE FLOW PAST BLUFF BODIES BY A VORTEX METHOD Ph.D. Thesis

Andrew P. Burrows 1990 132 p Sponsored by Science Research Council

(Aero-Rept-9016; ETN-92-90931) Avail: NTIS HC/MF A07

A review of the literature on vortex methods for the representation of vortex sheets and the literature in two dimensional viscous incompressible flow past bluff bodies, mainly the circular cylinder, both experimental and numerical, with emphasis on the use of vortex methods, is presented. An algorithm for the transport of vorticity in two dimensional incompressible flow past a circular cylinder is considered. The algorithm considered only Reynolds numbers (Re) 20, 40, 100 and 200. The physical predictions of this approach for uniform flow past a circular cylinder over a wider range of Re, and to mathematically develop and apply the algorithm to other flows and bodies, are further investigated. The working Re of the method is extended up to 1000, and down to 2. Steady symmetric fully developed flow is studied for Re between 2 and 500, and the symmetric starting flow is examined for Re greater than or equal to 100 and less than or equal to 500. A rotating cylinder is considered next for Re greater than or equal to 5 and less than or equal to 200. The algorithm is developed for a noncircular body, and the flow past an elliptic cylinder at incidence is studied for Re greater than or equal to 15 and less than or equal to 200. The results from the above works are compared, where possible, with the available literature. This study led to the development of a versatile algorithm for two dimensional bluff body flows which can be adapted for application to arbitrary body shapes and used to calculate aerodynamic forces, Strouhal numbers, and vorticity distributions in the flow field and to the discovery of various interesting physical phenomena. ESA

N92-18292# Manchester Univ. (England). Aeronautical Engineering Group.

THE SOLUTION OF BOUNDARY LAYER PROBLEMS BY THE USE OF INTEGRAL EQUATIONS: BASIC EQUATIONS AND THE DEVELOPMENT OF THE PRESSURE GRADIENT CLOSURE RELATIONS

D. I. A. Poll 1991 31 p

(Aero-Rept-9101; ETN-92-90932) Avail: NTIS HC/MF A03

The integral equations for mass, momentum, and energy within a compressible boundary layer were developed for a gas in thermochemical equilibrium and with arbitrary wall transpiration. For the case of zero wall transpiration, solutions for the momentum and energy equations can be obtained analytically provided that appropriate closure relations are available. The primary objective was to expand and extend work on the closure relations with particular interest in the Pressure Gradient Closure (PGC) technique for laminar flow. The derivation of this technique was completed and, having obtained the general form, the specific examples of the stagnation point and zero pressure gradient flow were examined. Comparisons with more physically realistic solutions reveal that the current implementation of the PGC method becomes unacceptably inaccurate for wall to total enthalpy ratios below about 0.5. Unfortunately, this is the area in which the accuracy should be good if the method is to be usable. The problem associated with PGC was shown to be linked to the relationship which is used to connect fluid viscosity and temperature and it appears that a practical solution is to introduce the reference temperature concept. For situations in which the flow is accelerating in the streamwise direction, the modification produced a dramatic improvement in the accuracy of the predictions. ESA

N92-18317# Manchester Univ. (England). Aeronautical Engineering Group.

PROPAGATION OF SHOCK WAVES THROUGH CLOUDS Ph.D. Thesis

Xin Xin Zhou Oct. 1990 150 p

(Aero-Rept-9104; ETN-92-90935) Avail: NTIS HC/MF A07

The behavior of a shock wave propagating into a cloud consisting of an inert gas, water vapor and water droplets was investigated. This has particular application to sonic bangs propagating in the atmosphere. The finite different method of MacCormack is extended to solve the one and two dimensional, two phase flow problems in which mass, momentum and energy transfers are included. The FCT (Fluid Corrected Transport) technique developed by Boris and Book was used in the basic numerical scheme as a powerful corrective procedure. The results for the transmitted shock waves propagating in a one dimensional, semi infinite cloud obtained by the finite difference approach are in good agreement with previous results by Kao using the method characteristics. The advantage of the finite difference method is its adaptability to two and three dimensional problems. Shock wave propagation through a finite cloud and into an expansion with a 90 degree corner was investigated. It was found that the transfer processes between the two phases in two dimensional flow are much more complicated than in the one dimensional flow cases. This is mainly due to the vortex and expansion wave generated at the corner. In the case considered, further complications were generated by the reflected shock wave from the floor. Good

agreement with experiment was found for one phase flow but experimental data for the two phase case is not yet available to validate the two phase calculations. ESA

N92-18319# Manchester Univ. (England). Aeronautical Engineering Group.
ON THE APPROXIMATE REPRESENTATION OF VELOCITY AND SHEAR STRESS DISTRIBUTIONS IN LOW-SPEED BOUNDARY LAYERS Ph.D. Thesis Final Report
Philip Carter and D. I. A. Poll 1990 167 p
(Contract MOD-2052/77/RAE(F))
(Aero-Rept-9012; ETN-92-90938) Avail: NTIS HC/MF A08

A method for the representation of mean shear stress and velocity profiles in low speed, laminar and turbulent boundary layers is described. It has a unique advantage over existing techniques in that the distributions of velocity and stress may be related by any turbulence model. This makes the profiles particularly useful as starting solutions for complex flow calculations. Two methods for obtaining the mean shear stress distribution are proposed. The first uses a near wall solution of the x momentum equation and an 'intermittency' or 'smoothing' function. The alternative approach represents the shear stress distribution using a power series with suitable boundary conditions specified at the wall and at the edge of the boundary layer. In both cases the velocity profiles are obtained by integrating the shear stress profiles using a turbulence model or by setting the turbulent Reynolds stresses to zero in the case of laminar flow. Velocity profiles, shear stress profiles and integral properties obtained from the technique are compared with experimental data and predictions from the Cebeci-Smith full field method. Predictions for laminar flow profiles are compared with the Falkner-Skan solutions. ESA

N92-18320# Manchester Univ. (England). Aeronautical Engineering Group.
NUMERICAL SOLUTIONS FOR UNIFORM FLOW AROUND SYMMETRICAL BODIES USING PANEL METHODS M.S. Thesis
Iad Anton Farah Oct. 1990 35 p
(Aero-Rept-9014; ETN-92-90939) Avail: NTIS HC/MF A03

The convergence properties of two dimensional panel methods were recently studied to determine the effect on rates of convergence of singularity strength variation along a panel and panel curvature. The panel methods were applied to several simple benchmark test cases for which analytical results were available for singularity distribution as well as velocity distribution on the body. This work was limited to source sink panels. The results are reviewed and the approach is extended to study vortex panels. ESA

N92-18323# National Aerospace Lab., Amsterdam (Netherlands). Informatics/Aerodynamics Div.
VISIAN: A VISCOUS-INVISCID STRONG-INTERACTION ANALYSIS SYSTEM
A. E. P. Veldman, J. P. F. Lindhout, and E. deBoer 16 May 1988 98 p
(Contract NIVR-01901N)
(NLR-TR-88081-U; ETN-92-90952) Avail: NTIS HC/MF A05

A description of VISIAN, a simulation method for two dimensional viscous flows with strong viscous inviscid interaction is given. The mathematical model and the numerical algorithm are presented. VISIAN was coupled with the inviscid flow solver TRAFS. Results for a number of airfoils are shown and a comparison with results from other computations and with experiments is made. ESA

N92-18372# International Centre for Theoretical Physics, Trieste (Italy).
CLASSICAL SOLUTIONS OF TWO DIMENSIONAL STOKES PROBLEMS ON NON SMOOTH DOMAINS. 2: COLLOCATION METHOD FOR THE RADON EQUATION
M. S. Lubuma May 1991 21 p
(DE92-603632; IC-91/93) Avail: NTIS HC/MF A03

The nonuniquely solvable Radon boundary integral equation for the two-dimensional Stokes-Dirichlet problem on a nonsmooth domain is transformed into a well posed one by a suitable compact perturbation of the velocity double layer potential operator. The solution to the modified equation is decomposed into a regular part and a finite linear combination of intrinsic singular functions whose coefficients are computed from explicit formulae. Using these formulae, the classical collocation method, defined by continuous piecewise linear vector-valued basis functions, which converges slowly because of the lack of regularity of the solution, is improved into a collocation dual singular function method with optimal rates of convergence for the solution and for the coefficients of singularities. DOE

N92-18438# Notre Dame Univ., IN. Dept. of Chemical Engineering.
STUDY OF INTERFACIAL BEHAVIOR IN COCURRENT GAS-LIQUID FLOWS
M. J. McCready Nov. 1991 19 p
(Contract DE-FG02-88ER-13913)
(DE91-019081; DOE/ER-13913/4) Avail: NTIS HC/MF A03

From video images of the interface of a gas-sheared liquid layer at conditions moving away from neutral stability, a mechanism by which the two-dimensional wave field becomes unstable to transverse disturbances has been observed. It is seen that the first transverse variation is caused by a varicose instability in which two oblique modes with transverse wavenumbers (plusor minus k(sub y) k(sub y) = 2 pi/lamba (sub y), and streamwise wavenumber, k(sub x), equal to the fundamental, appear simultaneously. Two-dimensional Fourier-Transforms show that k(sub y) is 0 for the 2-D case (as expected) but moves off axis to a value of k(sub y) which corresponds to a wavelength of about 5-10 cm when transverse variation is observed. A theoretical analysis based on an integral boundary-layer analysis of the Navier-Stokes equations agrees with the observed mechanism of transverse instability of finite amplitude two-dimensional waves -- at least for the conditions of the experiment. Because the theory is limited to conditions where the long wavelength, small amplitude assumptions are valid, and also because no viscous boundary conditions are presently included at the side walls of our 30.5 cm wide channel, it is not known if this a generic result. Experiments are planned to investigate this further; we are presently working on a more general theory which will remove the long wavelength restriction. DOE

N92-18483# National Aerospace Lab., Tokyo (Japan). Aircraft Aerodynamics Div.
PROCEEDINGS OF THE SEMINAR ON INVESTIGATION AND CONTROL OF BOUNDARY-LAYER TRANSITION [KYOKAISO SENI NO KAIMEI TO SEIGYO KENKYUKAI KOENSHU]
Nobutake Ito, Michio Nishioka, Kiyoshi Yamamoto, Yasuaki Kohama, Naoki Hirose, Yoji Ishida, Michio Oji, Shohei Takagi, Akira Ito (Meiji Univ., Kawasaki, Japan), and Ichiro Tani et al Jan. 1990 68 p In JAPANESE Lectures held from Sep. 1987 - Feb. 1989
(NAL-SP-11; ISSN-0289-260X; JTN-92-80287) Avail: NTIS HC/MF A04

This report is a proceeding of 22 lectures presented at the study meeting on the Investigation and Control of Boundary-Layer Transition held four times from September 1987 to February 1989. It contains reports on the analysis of transition mechanism, three-dimensional boundary-layer transition, transition control, and other topics. This group consists of researchers participating in applications research for fundamental studies on boundary layer transition, with the aim of exchanging their opinions and discussing them thoroughly. Recently, lectures and discussions have been ranging over more subjects including not only transition problems but also analysis of turbulence flows and control methods to reduce viscous resistance. Author (NASDA)

N92-18682# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
GAS-LIQUID ANNULAR FLOW IN VERTICAL CIRCULAR TUBES WITH LIQUID PENETRATED IN NUCLEUS
E. Nogueira, N. C. L. Brum, and R. M. Cotta (Universidade Federal

do Rio de Janeiro, Brazil) 1990 6 p In PORTUGUESE; ENGLISH summary Presented at the 3rd National Meeting of Thermal Sciences, Itapema (Brazil), 10-12 Dec. 1990
(DE92-605364; INIS-BR-2812; CONF-9012116) Avail: NTIS HC/MF A02

A semi-analytical model is proposed for fully developed upward gas-liquid annular flow inside vertical circular tubes, by utilizing well known turbulence algebraic models for single-phase flows, within both streams, combined with empirical correlations for the gas-liquid interface friction factor. Direct integration of the associated momentum equations provide the velocity distribution for each phase, as well as overall quantities of practical interest such as liquid film thickness and pressure gradient. The effects of liquid droplets entrainment in the gas is specialized empirical correlations. Extensive comparisons with experimental results are made in order to demonstrate the consistency of the proposed model. DOE

N92-18683# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
TURBULENT CONVECTIVE HEAT AND MASS TRANSFER IN THE DEVELOPING REGION OF ELLIPTICAL DUCTS
H. T. M. Vinagre and P. R. S. Mendes (Pontificia Univ. Catolica, Rio de Janeiro, Brazil) 1990 6 p Presented at the 3rd National Meeting of Thermal Sciences, Itapema (Brazil), 10-12 Dec. 1990
(DE92-605365; INIS-BR-2815; CONF-9012116) Avail: NTIS HC/MF A02

Mass transfer experiments were performed to determine local heat and mass transfer coefficients for the turbulent flow in a duct with elliptical cross section. The naphthalene sublimation technique was employed to obtain the experimental results. Both entrance-region and fully developed results were obtained. The Reynolds number was varied in the overall range of 7000 to 60,000, whereas values of 0.12, 0.25 and 0.5 for the aspect ratio were investigated. The fully developed transport coefficients obtained were compared with the ones available in the open literature for parallel plates and circular tubes, and it was found that the coefficients are quite insensitive to aspect ratio variations. DOE

N92-18684# Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro.
ON MODELLING, MATHEMATICAL ANALYSIS, AND NUMERICAL TREATMENT OF THREE-DIMENSIONAL TRANSIENT TWO-PHASE COOLANT FLOW IN ENGINEERING SYSTEMS
M. Bottoni and W. Sengpiel (Kernforschungszentrum G.m.b.H., Karlsruhe, Germany, F.R.) 1990 6 p Presented at the 3rd National Meeting of Thermal Sciences, Itapema (Brazil), 10-12 Dec. 1990
(DE92-605542; INIS-BR-2813; CONF-9012116) Avail: NTIS HC/MF A02

The conservations equations of mass, momentum and enthalpy and the entropy inequality, written for a two phase flow in the local instantaneous form together with the respective jump conditions at the phase interfaces, are volume-averaged over Eulerian control cells yielding a system of coupled macroscopic governing equations for the separated phases suitable for the 3-D, transient numerical simulation of complex engineering systems. The equations for the separated phases are then combined to model the fluid mixture in the frame of a slip model. The state of the art of the numerical treatment of the discretized and linearized equations is presented with reference to solution methods of a resulting Poisson equation for pressure and enthalpy distributions. The above algorithms have been implemented in the computer programs BACCHUS-3D/TP and COMMIX-2. The application of these codes is reviewed with reference to the numerical simulation of sodium boiling experiments in bundle geometry and of forced and natural convection simulations in more complex geometrical configurations. DOE

N92-18703# Oak Ridge National Lab., TN.
FINITE VOLUME MODEL FOR FORCED FLOW/THERMAL GRADIENT CHEMICAL VAPOR INFILTRATION
T. L. Starr and A. W. Smith Mar. 1991 26 p Prepared in cooperation with Georgia Tech Research Inst., Atlanta, GA
(Contract DE-AC05-84OR-21400)
(DE92-003765; ORNL/Sub-85-55901/02) Avail: NTIS HC/MF A03

The forced flow/thermal gradient chemical vapor infiltration process (FCVI) has proven to be a successful technique for fabrication of ceramic matrix composites. It is particularly attractive for thick components which cannot be fabricated using the conventional, isothermal method (ICVI). Although it offers processing times that are at least an order of magnitude shorter than ICVI, FCVI has not been used to fabricate parts of complex geometry and is perceived by many to be unsuitable for such components. The major concern is that selection and control of the flow pattern and thermal profile for optimum infiltration can be a difficult and costly exercise. In order to reduce this effort, we are developing a computer model for FCVI that simulates the densification process for given component geometry, reactor configuration and operating parameters. Used by a process engineer, this model can dramatically reduce the experimental effort needed to obtain uniform densification. DOE

N92-18705# Sandia National Labs., Albuquerque, NM.
METHOD AND APPARATUS FOR ACOUSTIC PLATE MODE LIQUID-SOLID PHASE TRANSITION DETECTION Patent Application
D. S. Blair, inventor (to DOE), G. C. Frye, inventor (to DOE), R. C. Hughes, inventor (to DOE), S. J. Martin, inventor (to DOE), and A. J. Ricco, inventor (to DOE) 31 May 1990 19 p
(Contract DE-AC04-76DP-00789)
(DE92-003778; US-Patent-Appl-SN-531492; Patents-US-A7531492) Avail: NTIS HC/MF A03

A method and apparatus for sensing a liquid-solid phase transition event is provided which comprises an acoustic plate mode detecting element placed in contact with a liquid or solid material which generates a high-frequency acoustic wave that is attenuated to an extent based on the physical state of the material in contact with the detecting element. The attenuation caused by the material in contact with the acoustic plate mode detecting element is used to determine the physical state of the material being detected. The method and device are particularly suited for detecting conditions such as the icing and deicing of wings of an aircraft. In another aspect of the present invention, a method is provided wherein the adhesion of a solid material to the detecting element can be measured using the apparatus of the invention. DOE

N92-18745# Texas Univ., Austin. Inst. for Fusion Studies.
EDGE TURBULENCE SCALING WITH SHEAR FLOW
Y. Z. Zhang and S. M. Mahajan Nov. 1991 10 p
(Contracts DE-FG05-80ET-53088; DE-FG05-88ER-53266)
(DE92-004249; DOE/ET-53088/526; IFSR-526) Avail: NTIS HC/MF A02

A formula relating turbulence levels with arbitrary shear flow is derived. When the diffusion coefficient is made a functional of the corresponding turbulence level, it is found that the scaling laws governing turbulence suppression are considerably modified. The results are compared with known formulas in various limiting cases; indicating that turbulence suppression mainly pertains in the moderate shear flow regime. The results also show that a flattened (steep) radial equilibrium gradient tends to enhance (eliminate) turbulence suppression due to the shear flow. DOE

N92-18775*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MULTIGRID ACCELERATION AND TURBULENCE MODELS FOR COMPUTATIONS OF 3D TURBULENT JETS IN CROSSFLOW
A. O. Demuren (Old Dominion Univ., Norfolk, VA.) Nov. 1991 23 p

(NASA Order C-99066-G)
(NASA-TM-105306; ICOMP-91-20; E-6658; NAS 1.15:105306; CMOTT-91-09) Avail: NTIS HC/MF A03 CSCL 20D

A multigrid method is presented for the calculation of three-dimensional turbulent jets in crossflow. Turbulence closure is achieved with either the standard k-epsilon model or a Reynolds Stress Model (RSM). Multigrid acceleration enables convergence rates which are far superior to that for a single grid method. With the k-epsilon model the rate approaches that for laminar flow, but with RSM it is somewhat slower. The increased stiffness of the system of equations in the latter may be responsible. Computed results with both turbulence models are compared with experimental data for a pair of opposed jets in crossflow. Both models yield reasonable agreement with mean flow velocity but RSM yields better prediction of the Reynolds stresses. Author

N92-18777*# State Univ. of New York, Buffalo. Dept. of Mechanical and Aerospace Engineering.
LARGE EDDY SIMULATIONS AND DIRECT NUMERICAL SIMULATIONS OF HIGH SPEED TURBULENT REACTING FLOWS Semiannual Report, 1 May - 31 Oct. 1991
P. Givi, C. K. Madnia, C. J. Steinberger, S. H. Frankel, and T. J. Vidoni 31 Oct. 1991 27 p
(Grant NAG1-1122)
(NASA-CR-189492; NAS 1.26:189492) Avail: NTIS HC/MF A03 CSCL 20D

The main objective is to extend the boundaries within which large eddy simulations (LES) and direct numerical simulations (DNS) can be applied in computational analyses of high speed reacting flows. In the efforts related to LES, we were concerned with developing reliable subgrid closures for modeling of the fluctuation correlations of scalar quantities in reacting turbulent flows. In the work on DNS, we focused our attention to further investigation of the effects of exothermicity in compressible turbulent flows. In our previous work, in the first year of this research, we have considered only 'simple' flows. Currently, we are in the process of extending our analyses for the purpose of modeling more practical flows of current interest at LaRC. A summary of our accomplishments during the third six months of the research is presented. Author

N92-18809*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
FREQUENCY EFFECTS ON THE STABILITY OF A JOURNAL BEARING FOR PERIODIC LOADING
D. Vijayaraghavan and D. E. Brewe 1991 21 p Presented at the STLE-ASME Joint Tribology Conference, St. Louis, MO, 13-16 Oct. 1991
(DA Proj. 1L1-61102-AH-45)
(NASA-TM-105226; E-6242; NAS 1.15:105226; AVSCOM-TR-91-C-040) Avail: NTIS HC/MF A03 CSCL 20D

The stability of a journal bearing is numerically predicted when a unidirectional periodic external load is applied. The analysis is performed using a cavitation algorithm, which mimics the Jakobsson-Floberg and Olsson (JFO) theory by accounting for the mass balance through the complete bearing. Hence, the history of the film is taken into consideration. The loading pattern is taken to be sinusoidal and the frequency of the load cycle is varied. The results are compared with the predictions using Reynolds boundary conditions for both film rupture and reformation. With such comparisons, the need for accurately predicting the cavitation regions for complex loading patterns is clearly demonstrated. For a particular frequency of loading, the effects of mass, amplitude of load variation and frequency of journal speed are also investigated. The journal trajectories, transient variations in fluid film forces, net surface velocity and minimum film thickness, and pressure profiles are also presented. Author

N92-18860# Stanford Univ., CA. Dept. of Aeronautics and Astronautics.
INVESTIGATION OF BURNETT EQUATIONS FOR TWO-DIMENSIONAL HYPERSONIC FLOW Final Report, 1 Oct. 1990 - 30 Sep. 1991
Dean R. Chapman and R. W. MacCormack 31 Oct. 1991 34 p
(Grant AF-AFOSR-0005-91; AF Proj. 2307)
(AD-A244395; AFOSR-91-1029TR) Avail: NTIS HC/MF A03 CSCL 20/4

In 1935, D. Burnett developed a higher order set of constitutive stress relationships from a class of solutions to the Boltzman equations. Our research on Burnett equations has identified five basic scientific issues in need of resolution before really satisfactory computations of 2D (or 3D) flow fields can be made with these equations. These issues relate to (1) surface boundary conditions, (2) frame independence, (3) material derivative approximation, (4) positive-definite dissipation, and (5) upper altitude limit for applicability. This report describes progress in areas 1, 3, and 4, and also an investigation of the interaction of a thick oblique shock impinging on a cowl lip in high-altitude hypersonic flow. GRA

N92-18872# Texas Univ., Dallas.
APPLICATIONS OF LASER-INDUCED EXCIPLEX FLUORESCENCE TO SINGLE DROPLET AND FUEL SPRAY VISUALIZATION Final Report, 15 Oct. 1987 - 15 May 1991
Lynn A. Melton 12 Jul. 1991 10 p
(Contract DAAL03-87-K-0120)
(AD-A244390; ARO-25584.8-EG) Avail: NTIS HC/MF A02 CSCL 21/4

The purpose of the work described in this final report is to develop and exploit (exciplex-based) fluorescence diagnostics in order to investigate the heating and vaporization of hydrocarbon fuel droplets in both isolated and fuel spray environments. In the course of the investigations, experimental and computational techniques have been developed (1) for imaging (and correcting images) of an equatorial 'slice' of sub-millimeter diameter droplets, (2) for exciplex fluorescence thermometry of optically thick droplets ('surface temperatures') and optically thin droplets ('volume averaged temperatures'), (3) for generation and/or study of droplets, particularly at pressures greater than 25 atmospheres, and (4) for two dimensional imaging of radiative lifetimes (equivalence ratio imaging). GRA

N92-18901# Minnesota Univ., Minneapolis. Dept. of Aerospace Engineering and Mechanics.
SELECTED TOPICS IN THE RHEOLOGY OF FLUIDS Final Report
Daniel D. Joseph 25 Aug. 1991 12 p
(Contract DAAL03-88-K-0083)
(AD-A244192; ARO-25648.26-MA) Avail: NTIS HC/MF A03 CSCL 20/4

Problems of flow of viscoelastic liquids were considered emphasizing the issues generated by the fluid's elasticity, which gives rise to hyperbolicity and waves. These studies are summarized with many studies of drag reductions using water lubrication, riblets, and polymers. These studies will be summarized in my new book (with Yuriko Renardy): Two-Fluid Dynamics. We started a computational numerical effort aimed at studying the motion of particles in fluids using the Navier Stokes equations and the particle equations of motion. GRA

N92-18933# Imperial Coll. of Science and Technology, London (England).
THE 8TH SYMPOSIUM ON TURBULENT SHEAR FLOWS. VOLUME 1: SESSIONS 1-18
Sep. 1991 522 p Symposium held in Munich, Fed. Republic of Germany, 9-11 Sep. 1991
(Contract DAJA45-91-M-0079)
(AD-A243809; R/D-6662-AN-02) Avail: NTIS HC/MF A22 CSCL 20/4

Session topics in this volume include wall flow, mixing layers, free shear flow, two phase flow, aerodynamic flow, unsteady flow, atmospheric flow, applications, separated flow, transition, homogenous flow, and transition and control. GRA

N92-18934# Imperial Coll. of Science and Technology, London (England).
THE 8TH SYMPOSIUM ON TURBULENT SHEAR FLOWS: VOLUME 2: 19-31, POSTER SESSIONS.
Sep. 1991 485 p Symposium held in Munich, Fed. Republic of Germany, 9-11 Sep. 1991
(Contract DAJA45-91-M-0079)
(AD-A243810; R/D-6662-AN-01) Avail: NTIS HC/MF A21
CSCL 20/4

Session topics in this volume include large eddy simulations, separated flows, compressible flows, combustion, buoyant flows and heat transfer, complex free flow, closures, coherent structures, rotation, and curvature effects. GRA

N92-18965*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
NUMERICAL SIMULATION OF TRANSIENT HYPERVELOCITY FLOW IN AN EXPANSION TUBE Final Report
P. A. Jacobs Jan. 1992 58 p
(Contract NAS1-18605)
(NASA-CR-189601; NAS 1.26:189601; ICASE-IR-20) Avail: NTIS HC/MF A04 CSCL 20D

Several numerical simulations of the transient flow of helium in an expansion tube are presented. The aim of the exercise is to provide further information on the operational problems of the NASA Langley expansion tube. The calculations were performed with an axisymmetric Navier-Stokes code based on a finite-volume formulation and upwinding techniques. Although laminar flow and ideal bursting of the diaphragms was assumed, the simulations showed some of the important features seen in the experiments. In particular, the discontinuity in the tube diameter at the primary diaphragm station introduced a transverse perturbation to the expanding driver gas, and this perturbation was seen to propagate into the test gas under some flow conditions. The disturbances seen in the test flow can be characterized as either 'small-amplitude' noise possibly introduced during shock compression or 'large-amplitude' noise associated with the passage of the reflected head of the unsteady expansion. Author

N92-19025*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
EFFECTIVE EQUATIONS AND THE INVERSE CASCADE THEORY FOR KOLMOGOROV FLOWS Final Report
E. Weinan and Chi-Wang Shu Jan. 1992 23 p Submitted for publication
(Contracts NAS1-18605; NAG1-1145; DAAL03-89-K-0039; DAAL03-91-G-0123; N00014-86-K-0691; AF-AFOSR-0090-90)
(NASA-CR-189599; NAS 1.26:189599; ICASE-92-2) Avail: NTIS HC/MF A03 CSCL 20D

We study the two dimensional Kolmogorov flows in the limit as the forcing frequency goes to infinity. Direct numerical simulation indicates that the low frequency energy spectrum evolves to a universal kappa (exp -4) decay law. We derive effective equations governing the behavior of the large scale flow quantities. We then present numerical evidence that with smooth initial data, the solution to the effective equation develops a kappa (exp -4) type singularity at a finite time. This gives a convenient explanation for the kappa (exp -4) decay law exhibited by the original Kolmogorov flows. Author

35 INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography.

For aerial photography see *43 Earth Resources and Remote Sensing.* For related information see also *06 Aircraft Instrumentation,* and *19 Spacecraft Instrumentation.*

N92-18026# Fermi National Accelerator Lab., Batavia, IL.
THE FERMILAB D0 MASTER CLOCK SYSTEM
C. Rotolo, M. Fachin, S. Chappa, M. Rauch, C. Needles, and A. Dyer Nov. 1991 6 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC02-76CH-03000)
(DE92-004120; FNAL/C-91/297; CONF-911106-38) Avail: NTIS HC/MF A02

The clock system provides bunch crossing related timing signals to various detector subsystems. Accelerator synchronization and monitoring as well as timing signal generation and distribution are discussed. The system is built using three module types implemented in Eurostandard hardware with a VME communications interface. The first two types of modules are used to facilitate synchronization with the accelerator and to generate 23 timing signals that are programmable with one RF bucket (18.8 ns) resolution and 1 ns accuracy. Fifty-four of the third module type are used to distribute the timing signals and two synchronous 53 MHz and 106 MHz clocks to various detector subsystems. DOE

N92-18027# Fermi National Accelerator Lab., Batavia, IL.
STATUS OF THE SILICON STRIP HIGH-RATE FASTBUS READOUT SYSTEM
H. Gonzalez, E. Barsotti, M. Bowden, D. Christian, J. Chramowicz, M. Fachin, M. Haldeman, J. Hoff, S. Holmes, and C. Rotolo et al Nov. 1991 6 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract DE-AC02-76CH-03000)
(DE92-004121; FNAL/C-91/302; CONF-911106-37) Avail: NTIS HC/MF A02

Our new readout system was developed in collaboration with, and largely to the specification of, the E771 experimenters. E771 is a fixed target experiment designed to study the production of B hadrons by an 800 GeV/c proton beam. The experiment will operate at rates of up to 200 million beam protons per second and 10 million interactions per second. The experimental apparatus will consist of an open geometry magnetic spectrometer featuring good muon and electron identification (much of which was used in E705), and a compact 16000 channel Silicon Strip Detector. In order to satisfy the experimenter's desire to instrument 16000 SSD elements in a package only 5 cm wide, 5 cm high, and 21 cm deep, and in order to meet the performance specifications, we have made extensive use of application specific integrated circuits (ASIC's). DOE

N92-18043# California Univ., Berkeley. Lawrence Berkeley Lab.
VARIED LINE-SPACE GRATINGS AND APPLICATIONS
W. R. McKinney 15 Jul. 1991 16 p Presented at the 4th International Conference on Synchrotron Radiation Instrumentation, Chester, England, 15-19 Jul. 1991
(Contract DE-AC03-76SF-00098)
(DE92-003902; LBL-30456; CONF-910730-25) Avail: NTIS HC/MF A03

This paper presents a straightforward analytical and numerical method for the design of a specific type of varied line-space grating system. The mathematical development will assume plane or nearly-plane spherical gratings which are illuminated by convergent light, which covers many interesting cases for synchrotron radiation. The gratings discussed will have straight grooves whose spacing varies across the principal plane of the grating. Focal relationships and formulae for the optical grating-pole-to-exist-slit distance and grating radius previously presented by other authors will be derived with a symbolic algebra system. It is intended to provide the optical designer with the tools necessary to design such a system properly. Finally, some possible advantages and disadvantages for application to synchrotron radiation beamlines will be discussed. DOE

N92-18110 Materials Research Labs., Ascot Vale (Australia).
DESIGN OF A FLASHBULB FIRING UNIT FOR USE WITH HIGH SPEED CAMERAS
K. J. Lee Aug. 1991 14 p
(MRL-TN-594; AR-006-820) Copyright Avail: Issuing Activity

Details of the design and construction of a three channel, multiple flashbulb firing unit are reported. The unit is adaptable to a variety of high speed camera instrumentation configurations. It can be triggered by a 90 V pulse or by the application of a short circuit and is capable of initiating up to 30 PF300 flashbulbs.
Author

N92-18197 Department of the Navy, Washington, DC.
GYROKLYSTRON DEVICE HAVING MULTI-SLOT BUNCHING CAVITIES Patent
Steven H. Gold, inventor (to Navy) and Arne W. Fliflet, inventor (to Navy) 6 Aug. 1991 9 p Filed 31 Jan. 1989
(AD-D015155; US-Patent-5,038,077; US-Patent-Appl-SN-304442; US-Patent-Class-315-539) Avail: US Patent and Trademark Office CSCL 09/1

A gyrokystron device includes an electron beam source, a plurality of bunching cavities and an output cavity. A first bunching cavity has an input coupling aperture for receiving an rf signal from an RF signal injecting source. Each of the bunching cavities has a first pair of substantially uniform-angle slots of a preselected angle, which are diametrically opposed, and extend axially, parallel to the direction of the electron beam and extend into drift regions on both sides of the cavities. The first pair of slots control the Q of a desired mode and higher order modes. A second and third pair of slots are diametrically opposed and extend axially, parallel to the direction of the first pair of slots, but are rotated 90 degrees circumferentially from the first pair of slots. These slots control the axial profile of any mode that leaks out beyond the desired mode and control the length of field interaction with the electron beam. The second and third pair of slots begin in the walls of drift regions just beyond the first pair of slots, and have a preselected angle at their beginning and the angle increases in size along an axial distance away from the cavities. An outer vacuum jacket lined with RF absorbing material is also included such that RF energy leaving through the slots will not return.
Author (GRA)

N92-18198 Department of the Navy, Washington, DC.
THIN FILM VECTOR MAGNETOMETER Patent
Paul Hunter, inventor (to Navy) and Leonard J. Schwee, inventor (to Navy) 24 Sep. 1991 6 p Filed 16 May 1990
(AD-D015157; US-Patent-5,051,695; US-Patent-Appl-SN-523198; US-Patent-Class-324-249) Avail: US Patent and Trademark Office CSCL 17/6

A thin film vector magnetometer is configured to produce an output that varies linearly with the component of an externally applied magnetic field in the plane of a thin film chip portion thereof along a predefined sensitivity axis. The sensitivity and linear dynamic range of the thin film vector magnetometer are intimately related to each other through a bias field supplied by a bias magnet portion of the device. The bias field also defines the sensitivity axes of the magnetometer which is orthogonal to the unidirectional bias field supplied by the bias magnet. GRA

N92-18267*# Sverdrup Technology, Inc., Brook Park, OH.
ASSESSING THE CONTRIBUTIONS OF SURFACE WAVES AND COMPLEX RAYS TO FAR-FIELD MIE SCATTERING BY USE OF THE DEBYE SERIES
Edward A. Hovenac and James A. Lock (Cleveland State Univ., OH.) Nov. 1991 47 p
(Contract NAS3-25266)
(NASA-CR-187191; E-6711; NAS 1.26:187191) Avail: NTIS HC/MF A03 CSCL 14B

The contributions of complex rays and the secondary radiation shed by surface waves to scattering by a dielectric sphere are calculated in the context of the Debye series expansion of the Mie scattering amplitudes. Also, the contributions of geometrical rays are reviewed and compared with the Debye series. Interference effects between surface waves, complex waves, and geometrical waves are calculated, and the possibility of observing these interference effects is discussed. Experimental data supporting the observation of a surface wave-geometrical pattern is presented.
Author

N92-18314# Technische Univ., Eindhoven (Netherlands).
MICROCALORIMETRY BELOW 1 KELVIN: SPECIFIC EXAMPLES AND DEVELOPMENTS Ph.D. Thesis
Gang Chen 1991 126 p
(ETN-92-90571) Avail: NTIS HC/MF A07

Subjects related to the design and development of microcalorimeters are described. The construction of a medium size (He-3)-(He-4) dilution refrigerator which can carry out experiments below 1 K is described. The construction and test of a microcalorimeter to operate in the 0.1 to 1 K range for small samples (less than or equal to 100 mg) and based on the relaxation time method is described. Various construction aspects, including the heat sink responsible for temperature regulation, are considered. Two prototypes were constructed and specific heats of two different kinds of samples were measured to test the applicability: on a high T sub c superconductor Bi2Sr2CaCu2O8 and antiferromagnetic insulating crystal (Cr(en)3)Cl3.0.5NaCl.3H2O. In order to reduce the heat capacity of the calorimeter itself, the feasibility of integrating all the components of a calorimeter in a single Si chip was studied. Arsenic ion implanted silicon chips were chosen, as the sample devices to be studied. Close examination of their temperature resistance and current-voltage characteristics showed many interesting characteristics of the ion implanted Si chips for both theoretical and practical purposes.
ESA

N92-18440*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
GODDARD SPACE FLIGHT CENTER SPECIFICATION FOR HELICAL-SCAN 8-MILLIMETER (mm) MAGNETIC DIGITAL DATA TAPE CARTRIDGE
Jimmy L. Perry Jan. 1992 63 p
(NASA-TM-104558; Rept-92B00036; NAS 1.15:104558) Avail: NTIS HC/MF A04 CSCL 14B

The same kind of standard and controls are established that are currently in use for the procurement of new analog, digital, and IBM/IBM compatible 3480 tape cartridges, and 1 in wide channel video magnetic tapes. The Magnetic Tape Certification Facility (MTCF) maintains a Qualified Products List (QPL) for the procurement of new magnetic media and uses the following specifications for the QPL and Acceptance Tests: (1) NASA TM-79724 is used for the QPL and Acceptance Testing of new analog magnetic tapes; (2) NASA TM-80599 is used for the QPL and Acceptance Testing of new digital magnetic tapes; (3) NASA TM-100702 is used for the QPL and Acceptance Testing of new IBM/IBM compatible 3840 magnetic tape cartridges; and (4) NASA TM-100712 is used for the QPL and Acceptance Testing of new 1 in wide channel video magnetic tapes. This document will be used for the QPL and Acceptance Testing of new Helical Scan 8 mm digital data tape cartridges.
Author

N92-18456*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
USING SILICON DIODES FOR DETECTING THE LIQUID-VAPOR INTERFACE IN HYDROGEN
Paula J. Dempsey and Richard H. Fabik 1992 15 p Proposed for presentation at the 38th International Instrumentation Symposium, Las Vegas, NV, 26-30 Apr. 1992; sponsored by the Instrument Society of America
(NASA-TM-105541; E-6851; NAS 1.15:105541) Avail: NTIS HC/MF A03 CSCL 14B

Tests were performed using commercially available silicon diode temperature sensors to detect the location of the liquid-vapor interface in hydrogen during ground test programs. Results show that by increasing the current into the sensor, silicon diodes can be used as liquid level point sensors. After cycling the sensors from liquid to vapor several times, it was found that with a 30 mA (milliamps) input current, the sensors respond within 2 seconds by measuring a large voltage difference when transitioning from liquid to vapor across the interface. Nearly instantaneous response resulted during a transition form vapor to liquid. Detailed here are test procedures, experimental results, and guidelines for applying this information to other test facilities.
Author

N92-18518# Biotronics Technologies, Inc., Waukesha, WI.
TRANSCUTANEOUS ANALYTE MEASURING METHODS (TAMM), PHASE 2 Quarterly Progress Report No. 1, Sep. - Nov. 1991
Kenneth J. Schlager Nov. 1991 27 p
(Contract N00014-91-C-0190)
(AD-A243684) Avail: NTIS HC/MF A03 CSCL 12/6

The primary objectives of the first quarter of Phase 2 TAMM were the following: the design of a near infrared (NIR)-800 photodiode array spectrometer, two of which would be used in clinical testing during 1992; the development of advanced pattern recognition software for analyzing the data collected with the spectrometer; and the establishment of an ongoing, internal test program with the B1-102 infrared analyzer. The major effect during the first three months of the project was in developing the analytical software NETGEN. NETGEN is a set of analytical programs that combine the best features of neural networks and genetic algorithms. Artificial neural networks (ANNs) are a form of distributed parallel processing of information that attempts to simulate the human brain. For application in TAMM, ANNs are an alternative to previous pattern recognition methods used for predicting blood analyte concentrations from NIR spectra. GRA

N92-18706# Los Alamos National Lab., NM.
WARHEAD COUNTING USING NEUTRON SCINTILLATORS: DETECTOR DEVELOPMENT, TESTING, AND DEMONSTRATION
R. C. Byrd, G. F. Auchampaugh, C. E. Moss, and W. C. Feldman 1991 6 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract W-7405-eng-36)
(DE92-003798; LA-UR-91-3489; CONF-911106-18) Avail: NTIS HC/MF A02

Although the number of warheads on a missile can be determined relatively simply by a scan of the emitted gamma radiation, this approach may be considered too intrusive because of the possibility of revealing high resolution energy or position information. Neutron spectra are nearly featureless, and obtaining the position resolution needed to reveal warhead details would be very difficult. We describe the development of a fast neutron detector based on a boron-loaded plastic scintillator used previously for space applications. The detector rejects gammas and scattered low energy neutrons, and its segmentation allows narrow fan-shaped collimation within + or - 20 degs horizontally and + or - 50 degs vertically. Testing includes distinguishing between mockups with either two or three warheads and locating the ten warheads on a silo-based Peacekeeper missile. DOE

N92-18708# Pittsburgh Energy Technology Center, PA.
APPARATUS AND METHOD FOR SEPARATING CONSTITUENTS Patent Application
C. P. Maronde, inventor (to DOE) and R. P. Killmeyer, Jr., inventor (to DOE) 25 Jun. 1990 25 p
(DE92-003814; US-Patent-Appl-SN-542604;
Patents-US-A7542604) Avail: NTIS HC/MF A03

A centrifugal separator apparatus and method for improving the efficiency of the separation of constituents in a fluid stream is discussed. A cyclone separator includes an assembly for separately discharging both constituents through the same end of the separator housing. A rotary separator includes a rotary housing having a baffle disposed therein for minimizing the differential rotational velocities of the constituents in the housing, thereby decreasing turbulence, and increasing efficiency. The intensity of the centrifugal force and the time which the constituents reside within the housing can be independently controlled to improve efficiency of separation. DOE

N92-18712# Pennsylvania Univ., Philadelphia.
POSITRON RING SYSTEM USING ANGER-TYPE DETECTORS
J. S. Karp 15 Nov. 1991 10 p
(Contract DE-FG02-88ER-60642)
(DE92-004052; DOE/ER-60642/4) Avail: NTIS HC/MF A02

The major accomplishments of this year include (1) building and debugging a new set of coincidence electronics for our laboratory setup, (2) performing a series of detector experiments in the dry glove-box aimed at improving the performance of NaI(Tl) position-sensitive detectors, (3) modifying and debugging a Monte Carlo simulation code to test reconstruction algorithms and predict overall performance of a large solid angle PET scanner, (4) significant progress in the 3-D reprojection reconstruction algorithm and comparison to the 2-D single-slice algorithm and a 3-D multi-slice rebinning algorithm, (5) performance comparisons of the two PENN-PET scanners, which lead to a design for a large solid angle scanner with a 25-cm axial extent. DOE

N92-18754# Argonne National Lab., IL.
ASSOCIATED-PARTICLE SEALED-TUBE NEUTRON GENERATORS AND HODOSCOPES FOR NDA APPLICATIONS
E. Rhodes and C. W. Peters 1991 23 p Presented at the 20th Japan Conference on Radiation and Radioisotopes, Tokyo, Japan, 12-14 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-003423; ANL/CP-74572; CONF-9111125-1) Avail: NTIS HC/MF A03

With radioisotope sources, gamma-ray transmission hodoscopes can inspect canisters and railcars to monitor rocket motors, detect nuclear warheads by their characteristic strong gamma-ray absorption, or count nuclear warheads inside a missile by low-resolution tomography. Intrinsic gamma-ray radiation from warheads can also be detected in a passive mode. Neutron hodoscopes can use neutron transmission, intrinsic neutron emission, or reactions stimulated by a neutron source, in treaty verification roles. Gamma-ray and neutron hodoscopes can be combined with a recently developed neutron diagnostic probe system, based on a unique associated-particle sealed-tube neutron generator (APSTNG) that interrogates the object of interest with a low-intensity beam of 14-MeV neutrons, and that uses flight-time to electronically collimate transmitted neutrons and to tomographically image nuclides identified by reaction gamma-rays. Gamma-ray spectra of resulting neutron reactions identify nuclides associated with all major chemicals in chemical warfare agents, explosives, and drugs, as well as many pollutants and fissile and fertile special nuclear material. DOE

N92-18759*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
MINIATURE HIGH TEMPERATURE PLUG-TYPE HEAT FLUX GAUGES
Curt H. Liebert 1992 11 p Proposed for presentation at the 38th International Instrumentation Symposium, Las Vegas, NV, 26-30 Apr. 1992; sponsored by the Instrument Society of America
(NASA-TM-105403; E-6805; NAS 1.15:105403) Avail: NTIS HC/MF A03 CSCL 14B

The objective is to describe continuing efforts to develop methods for measuring surface heat flux, gauge active surface temperature, and heat transfer coefficient quantities. The methodology involves inventing a procedure for fabricating improved plug-type heat flux gauges and also for formulating inverse heat conduction models and calculation procedures. These models and procedures are required for making indirect measurements of these quantities from direct temperature measurements at gauge interior locations. Measurements of these quantities were made in a turbine blade thermal cycling tester (TBT) located at MSFC. The TBT partially simulates the turbopump turbine environment in the Space Shuttle Main Engine. After the TBT test, experiments were performed in an arc lamp to analyze gauge quality. Author

N92-18772# Argonne National Lab., IL.
MISALIGNMENT SENSITIVITY OF AN INCLINED CRYSTAL MONOCHROMATOR
A. T. Macrander and W. K. Lee Oct. 1991 11 p Presented at the 7th National Conference and Exhibition on Synchrotron Radiation Instrumentation, Baton Rouge, LA, 28-31 Oct. 1991
(Contract W-31-109-eng-38)

(DE92-004130; ANL/CP-74079; CONF-9110146-3) Avail: NTIS HC/MF A03

The sensitivity of a novel inclined crystal monochromator design to misalignments has been calculated, and compared to data. Rocking curve line narrowing as well as broadening can occur because the asymmetry factor of dynamical diffraction given by b=s(sub O) x n/s(sub H) x n can have an absolute value larger or smaller than unity. Here s(sub O) x n and s(sub H) x n are the direction cosines of the incident and diffracted beams, respectively, and n is the inward surface normal. An inclined double crystal monochromator which is perfectly aligned would have b = -1 for both crystals, and only then would the diffraction by symmetric. We have computed b and rocking curve widths for inclination angles of 70.53 degrees and 85.00 degrees, and we compare the 70.53 degree case to data for silicon (111) reflections using 8 KeV (CuK alpha sub 1) radiation. The 70.53 degree case applies to (11 bar 1) reflection from a (111) oriented crystal. We report that rotations around the reciprocal lattice vector have the expected effect on b. DOE

N92-18800# Argonne National Lab., IL.
NEW RADIATION HODOSCOPE DEVELOPMENTS FOR ARMS CONTROL TREATY VERIFICATION
C. E. Dickerman, R. C. Doerner, J. P. Regis, E. A. Rhodes, G. S. Stanford, D. J. Travis, and A. DeVolpi 1991 5 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-003391; ANL/CP-74511; CONF-911106-15) Avail: NTIS HC/MF A01

New developments in hodoscope radiation detection technology offer a wide range of unique capabilities for arms control treaty verification (ACTV) applications. Originally developed for civilian nuclear power research by Argonne National Laboratory, this concept uses an array of radiation detectors to image or detect objects inside opaque containments. Hodoscope systems may detect neutrons and/or gamma-rays. The systems may be based on transmission of radiation through the objects; may detect radiation stimulated in the objects, or may detect intrinsic object radiation. ACTV hodoscopes do not require the high-speed data acquisition systems or the heavy shielding and collimation of reactor hodoscopes, and relatively weak radiation sources are sufficient. We have performed laboratory measurements to demonstrate a range of potential applications. Gamma-ray transmission hodoscopes can be used to inspect items such as canisters and rail cars. The use of relatively weak radiation sources makes it unnecessary to employ expensive and high-intensity accelerators. The heavy metal of nuclear warheads is characterized by strong gamma-ray absorption, and these materials could be counted by low-resolution tomography. Absorbers located in line with objects will themselves be detected, and sources located in the object region will be subtracted out as background. Intrinsic gamma-ray radiation from warheads also can be detected in a passive-instrument mode. Neutron hodoscopes can utilize neutron transmission, intrinsic neutron emission, or neutron-producing reactions (either prompt or delayed) stimulated by a neutron source. Monitoring of rocket motors enclosed in canisters/rail cars is the focus of the most recent ACTV hodoscope research and development activities. DOE

N92-18897# Efratom Systems Corp., Irvine, CA.
TACTICAL RUBIDIUM FREQUENCY STANDARD (TRFS) Final Technical Report, Nov. 1983 - Oct. 1989
Werner Weidemann, William Cashin, and Thomas English Sep. 1991 114 p LIMITED REPRODUCIBILITY: Availability: Document partially illegible
(Contract F19628-83-C-0173)
(AD-A243934; RL-TR-91-245) Avail: NTIS HC/MF A06 CSCL 14/2

This report describes the accomplishments of a six-year R&D progress to design, build, and evaluate three Tactical Rubidium Frequency Standards (TRFS) units for the Air Force. The TRFS is a miniature atomic time and frequency source that can operate in a harsh, tactical military environment. The TRFS design must incorporate significant advances in miniaturization, ruggedness, fast warmup, and high-temperature operation required for aircraft operations. This report includes a detailed description of the TRFS design as developed at Efratom, the results of qualification tests on three TRFS units, and part reliability data obtained over the course of the contract. Author (GRA)

N92-18898# Frequency Electronics, Inc., Mitchel AFB, NY.
DEVELOPMENT OF AN OPTICALLY-PUMPED, CESIUM BEAM ATOMIC STANDARD Final Technical Report, Sep. 1985 - May 1989
T. McClelland and A. Vasilakis Oct. 1991 75 p
(Contract F19628-85-C-0192)
(AD-A243937; RL-TR-91-258) Avail: NTIS HC/MF A04 CSCL 14/2

This report describes the achievements over a four-year period on a research and development program to design, develop, and fabricate an optically-pumped atomic standard (OPAS). The OPAS device is a cesium beam atomic frequency standard in which the state selection and state detection are both accomplished by optical pumping using semiconductor laser diodes. Special emphasis is given in this report to the problems associated with the use of semiconductor laser diodes in this application, including mechanical, thermal, electrical, and optical development findings. GRA

N92-18909# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
CHARACTERIZATION OF A GYROTRON CAVITY AT 10 GHz
Pedro Jose deCastro, Joaquim Jose Barroso deCastro, Rafael Alves Correa, and Maria doCarmo deAndr Nono Apr. 1991 9 p Presented at the International Microwave Conference, Rio de Janeiro, Brazil, 22-25 Jul. 1991
(INPE-5257-PRE/1681) Avail: NTIS HC/MF A02

Experiments were conducted to characterize a gyrotron cavity designed to operate in the transverse electric (TE(sub 021)) mode at 10 GHz. Small holes were introduced into the cavity to couple in and detect the probing power. Evaluation of the loaded Q factor is based on bandwidth measurements whereas the standing-wave electric field profile is determined by using perturbation techniques. Good agreement between measured and predicted values of resonant frequencies and Q factors for several fundamental TE modes is found. Author

N92-18955# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
REAL IMAGERY AS A 3-DIMENSIONAL DISPLAY M.S. Thesis
Juan C. Echeverry Dec. 1991 119 p
(AD-A243820; AFIT/GEO/ENG/91D-01) Avail: NTIS HC/MF A06 CSCL 14/2

This research effort implemented two 3-D display designs to assess their performance and effect on an observer's depth perception. Both 3-D displays produced real images for the observer to view. The first display setup combined a lens relay with a two concave mirror projector. The second display setup combined the two concave mirror projector with a diffuser. The lens relay/two concave mirror projector combination was successful in imaging a source from the CRT to a point in space above the two mirror system. The problem was that the observer could not assess the image location by just looking at it because it lacked concrete horizontal and vertical references for the observer to assess along with the image. The three-dimensional effect produced by the image could not be assessed easily because of the limited size of the image. The diffuser/two concave mirror combination was more successful as a display because it was comfortable to view. The design took advantage of the three-dimensional imaging that the two mirror system was already capable of generating. This design produced an image that the observer easily perceived as floating above the two mirror system. In essence, the image of the diffuser appearing at the top of the mirror system acted as the horizontal and vertical reference that was lacking in the previous experiment.

The use of depth cues in the images gave the observer the ability to interpret depth. GRA

N92-18959# Federal Aviation Administration, Atlantic City, NJ.
HIGH CAPACITY VOICE RECORDER (HCVR) OPERATIONAL TEST AND EVALUATION (OT AND E)/INTEGRATION TEST PLAN
Wayne E. Bell, Andy Colon, and Edward Lind Feb. 1992 58 p
(DOT/FAA/CT-TN91/55) Avail: NTIS HC/MF A04

This plan addresses the Operational Test and Evaluation (OT&E)/Integration testing of the High Capacity Voice Recorder (HCVR) equipment in the current NAS environment. The approach and concept is to conduct integration tests with appropriate National Airspace System (NAS) subsystem to verify that NAS requirements and HCVR Purchase Description (PD) requirements have been satisfied. This will be accomplished by conducting unit level tests at the FAA Technical Center and extensive integration tests at Seattle Air Route Traffic Control Center (ARTCC). Author

36 LASERS AND MASERS

Includes parametric amplifiers.
For related information see also *76 Solid-State Physics.*

N92-18185 Department of the Navy, Washington, DC.
NARROW-BANDWIDTH UNSTABLE RESONATOR LASER CAVITY Patent
David G. Cooper, inventor (to Navy), John F. Reintjes, inventor (to Navy), and Lawrence L. Tankersley, inventor (to Navy) 27 Aug. 1991 10 p Filed 31 May 1990
(AD-D015148; US-Patent-5,043,998; US-Patent-Appl-SN-598513; US-Patent-Class-372-95) Avail: US Patent and Trademark Office CSCL 09/3

An unstable resonator laser cavity providing high power radiation with diffraction limited divergence and narrow bandwidth comprises a gain medium for generating and amplifying laser radiation optically coupled to a reflector via a frequency narrowing element for providing feedback and bandwidth narrowing of the laser radiation traveling between the gain medium and the reflector. A telescopic ring is optically coupled to the gain medium opposing the reflector. The telescopic ring comprises a polarized beam splitter, which transmits a first polarization polarized laser radiation into the telescopic ring traveling in a first direction and reflects a second polarization polarized laser radiation into the telescopic ring in a second direction; first and second rotators for rotating the first polarization polarized laser radiation to provide second polarization polarized laser radiation traveling in the first direction; and lenses for magnifying the second polarization polarized laser radiation traveling in the first direction onto the polarized beam splitter, which reflects the second polarization polarized laser radiation produced by the first and second rotators back into the gain medium. A scraper mirror, located between the gain medium and the reflector, provides the output beam. Author (GRA)

N92-18390# Lawrence Livermore National Lab., CA.
MATERIALS FOR DIODE PUMPED SOLID STATE LASERS
L. L. Chase, L. E. Davis, W. F. Krupke, and S. A. Payne 14 Jul. 1991 7 p Presented at the 2nd International Laser Conference: Material Engineering, Medicine, Biology, Physics and Chemistry, Grenoble, France, 9-11 Jul. 1991
(Contract W-7405-eng-48)
(DE92-003973; UCRL-JC-107363; CONF-910717-1) Avail: NTIS HC/MF A02

The advantages of semiconductor diode lasers and laser arrays as pump sources for solid state lasers are reviewed. The properties that are desirable in solid state laser media for various diode pumping applications are discussed, and the characteristics of several promising media are summarized. DOE

N92-18402# International Centre for Theoretical Physics, Trieste (Italy).
DEVELOPMENT OF TUNABLE FLASHLAMP EXCITED DYE LASER SYSTEM
V. Bhanthumnavin, S. Apikitmata, and P. Kochareon (King Mongkut's Inst. of Tech., Bangkok, Thailand) May 1991 9 p
(DE92-611160; LAMP-91/2) Avail: NTIS HC/MF A02

A tunable flashlamp excited dye laser (FEDL) was successfully developed for the first time in Thailand by Thai scientists at KMIT Thonburi (Bangmod). The Rhodamine 6G dissolved in ethyl alcohol was utilized as a laser medium and circulated by a pump through a laser head. The dye cuvette had an inner diameter of 4.0 mm and was 90 mm long. The cavity mirrors M(sub 1), and M(sub 2) were concave mirrors with reflectivities of 100 and 73 percent respectively. A power supply of 0-20 kV and current of 0-50 mA charged a capacitor of 0.3 micro-f at 10-15 kV which was then discharged via a spark gap through the flashlamp. The output laser wavelengths was tunable from lambda = 550-640 nm. It is the first FEDL system, locally developed, which has a tunable wavelength for the laser output. The laser pulse width is about 1.0 microsecond with energy of 20 mJ and peak power pf 20 KW. The repetition rate of the laser is 1/15 Hz. DOE

N92-18510# Lawrence Livermore National Lab., CA.
REFLECTOR FOR EFFICIENT COUPLING OF A LASER BEAM TO AIR OR OTHER FLUIDS Patent Application
J. T. Kare, inventor (to DOE) 18 Jul. 1990 27 p
(Contract W-7405-eng-48)
(DE92-003824; US-Patent-Appl-SN-554728; Patents-US-A7554728) Avail: NTIS HC/MF A03

A reflector array is disclosed herein that provides a controlled region or regions of plasma breakdowns from a laser beam produced at a remotely-based laser source. The plasma may be applied to produce thrust to propel a spacecraft, or to diagnose a laser beam, or to produce shockwaves. The spacecraft propulsion system comprises a reflector array attached to the vehicle. The reflector array comprises a plurality of reflectors spaced apart on a reflective surface, with each reflector acting as an independent focusing mirror. The reflectors are spaced closely together to form a continuous or partially-continuous surface. The reflector array may be formed from a sheet of reflective material, such as copper or aluminum. In operation, a beam of electromagnetic energy, such as a laser beam, is directed at the reflectors which focus the reflected electromagnetic energy at a plurality of regions off the surface. The energy concentrated in the focal region causes a breakdown of the air or other fluids in the focal region, creating a plasma. Electromagnetic energy is absorbed in the plasma and it grows in volume, compressing and heating the adjacent fluid thereby providing thrust. Laser pulses may be applied repetitively. After each such thrust pulse, fresh air can be introduced next to the surface either laterally or through a perforated surface. If air or some other gas or vapor is supplied, for example from a tank carried on board a vehicle, this invention may also be used to provide thrust in a vacuum environment. DOE

N92-18525# Lawrence Livermore National Lab., CA.
APPARATUS AND PROCESS FOR ACTIVE PULSE INTENSITY CONTROL OF LASER BEAM Patent Application
R. B. Wilcox, inventor (to DOE) 1990 17 p
(Contract W-7405-eng-48)
(DE92-003810; US-Patent-Appl-SN-540237; Patents-US-A7540237) Avail: NTIS HC/MF A03

An optically controlled laser pulse energy control apparatus and process is disclosed wherein variations in the energy of a portion of the laser beam are used to vary the resistance of a photodetector such as a photoresistor through which a control voltage is fed to a light intensity controlling device through which a second portion of the laser beam passes. Light attenuation means are provided to vary the intensity of the laser light used to control the resistance of the photodetector. An optical delay path is provided through which the second portion of the beam travels before reaching the light intensity controlling device. The control voltage is supplied by a variable power supply. The apparatus

may be tuned to properly attenuate the laser beam passing through the intensity controlling device by adjusting the power supply, the optical delay path, or the light attenuating means. DOE

N92-18568# Lawrence Livermore National Lab., CA.
LASER METROLOGY FOR COHERENT MULTI-TELESCOPE ARRAYS Patent Application
M. Shao, inventor (to DOE) and N. A. Massie, inventor (to DOE) 16 May 1990 39 p
(Contract W-7405-eng-48)
(DE92-004616; US-Patent-Appl-SN-524114;
Patents-US-A7524114) Avail: NTIS HC/MF A03

In multi-telescope arrays that comprise multiple telescopes, a beam-combining module, and flat mirrors for directing light beams from the multiple telescopes to the beam combining module, a laser metrology system is used for monitoring various pathlengths along a beam path where deviations are likely. Some pathlengths are defined simply by a pair of retroreflectors or reflectors at both ends. Lengths between pairs of retroreflectors are measured and monitored by laser interferometers. One critical pathlength deviation is related to the displacement of the flat mirror. A reference frame is set up relative to the beam-combining module to form and define the coordinate system within which the positions of the flat mirrors are measured and monitored. In the preferred embodiment, a pair of retroreflectors along the optical axis of the beam-combining module defines a reference frame. A triangle is formed by the reference frame at the base and another retroreflector at the flat mirror as the vertex. The triangle is used to monitor the position of the flat mirror. A beam's pathlength is dynamically corrected in response to the monitored deviation. DOE

N92-18679# International Centre for Theoretical Physics, Trieste (Italy).
LASER FIELD EFFECTS ON THE COLLECTIVE INVERSE BREMSSTRAHLUNG PROCESS
H. TorresSilva and P. H. Sakanaka Jul. 1991 16 p
(DE92-603840; IC-91/170) Avail: NTIS HC/MF A03

The energy loss method has been applied to a large variety of transport problems in optics, solid state and fusion research. Usually, the transport equations are linearized, so they cannot deal with the multiphoton interaction in the presence of an intense laser field. In particular, not much attention has been given to collective contribution to the rates of the energy loss and inverse Bremsstrahlung process from a quantum mechanical viewpoint. On the basis of the center of mass approach, we show the proper way to calculate the collective part of these rates, which depend on the energy loss function Im(-1/episolon(q vector, omega)). DOE

N92-18738# Brookhaven National Lab., Upton, NY.
PHOTOEMISSION USING FEMTOSECOND LASER PULSES
T. Srinivasan-Rao, T. Tsang, and J. Fischer Oct. 1991 13 p Presented at the 13th International Free-Electron Laser (FEL) Conference, Santa Fe, NM, 25-30 Aug. 1991
(Contract DE-AC02-76CH-00016)
(DE92-004997; BNL-46165; CONF-9108118-35) Avail: NTIS HC/MF A03

Successful operation of short wavelength FEL requires an electron bunch of current greater than 100 A and normalized emittance less than 1 mm-mrad. Recent experiments show that RF guns with photocathodes as the electron source may be the ideal candidate for achieving these parameters. To reduce the emittance growth due to space charge and RF dynamics effects, the gun may have to operate at high field gradient (hence at high RF frequency) and at a spot size small compared to the aperture. This may necessitate the laser pulse duration to be in the subpicosecond regime to reduce the energy spread. We will present the behavior of metal photocathodes upon irradiation with femtosecond laser beams, comparison of linear and nonlinear photoemission, and scalability to high currents. Theoretical estimate of the intrinsic emittance at the photocathode in the presence of the anomalous heating of the electrons, and the tolerance on the surface roughness of the cathode material is discussed. DOE

N92-18741# Brookhaven National Lab., Upton, NY.
ELECTRON BEAM OPTICS FOR THE FEL EXPERIMENT AND IFEL EXPERIMENT
A. vanSteenbergen 1990 30 p
(Contract DE-AC02-76CH-00016)
(DE92-005049; BNL-46840) Avail: NTIS HC/MF A03

Electron beam transport system parameters for the FEL experiment and for the FEL experiment are given. The perturbation of the 'interaction region' optics due to wiggler focussing is taken into account and a range of solutions are provided for relevant Twiss parameters in the FEL or IFEL region. Modifications of the transport optics in specific sections of the overall beam transport lines, for reasons of enhanced diagnostic capability or enhanced beam momentum analysis resolution, is also presented. DOE

37 MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

N92-18109 Department of the Navy, Washington, DC.
APPARATUS AND METHODS FOR DETERMINING BALANCE OF A CYLINDRICAL VEHICLE Patent Application
David Nugent, inventor (to Navy) 28 Aug. 1991 15 p
(AD-D015161; US-Patent-Appl-SN-750998; Navy-Case-73092)
Avail: NTIS HC/MF A02 CSCL 13/6

Apparatus and methods are described for determining the balance of a cylindrical vehicle, the apparatus comprising a frame adapted for horizontal disposition, first and second support assemblies mounted on the frame for receiving the vehicle, first and second load cells mounted, respectively, on the first and second support assemblies, whereby upon placement of the vehicle on the support assemblies the load cells are adapted to provide readings indicative of the weight of the vehicle, from which may be determined the center of gravity of the vehicle. A torsion cell assembly is mounted on the frame and adapted for connection to the vehicle and for providing indications of righting moment and static heel of the vehicle. GRA

N92-18120 Department of the Navy, Washington, DC.
SINGLE SCREW MECHANISM WITH GATEROTOR HOUSING AT INTERMEDIATE PRESSURE Patent
David C. Winyard, inventor (to Navy) 28 May 1991 11 p
Filed 31 May 1989
(AD-D015140; US-Patent-5,018,952; US-Patent-Appl-SN-359462)
Avail: US Patent and Trademark Office CSCL 13/7

This patent discloses an invention that is an improvement upon conventional single-screw mechanisms in that the gaterotor housing is substantially isolated from both the inlet and outlet port areas by a window opening path through the casing whereby the gaterotor teeth pass for engagement with the mainrotor. The window path has been extended and has close clearances provided on both sides of the entering gaterotor teeth creating two barriers to internal leakage thereby reducing window path losses, increasing volumetric efficiency, and allowing higher pressure capability. GRA

N92-18156# Argonne National Lab., IL.
TRANSPORTATION IN THE TWENTY-FIRST CENTURY
H. T. Coffey 1991 13 p Presented at the Clean Air Act Amendments: An Economic Opportunity for Illinois and the Midwest, Chicago, IL, 11 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-003521; ANL/CP-74752; CONF-9110278-1) Avail: NTIS HC/MF A03

New energy efficient and environmentally-sound magnetically levitated (maglev) transportation systems are being developed that have the potential to supplement and extend the intercity portion of our transportation system, and to alleviate part of the commuter congestion on our highways. Prototype passenger carrying maglev vehicles are now operating in Japan and Germany. The capabilities of these systems, described in science fiction over two decades ago, are no longer speculative. They will be capable of transporting

100 to 150 passengers per vehicle or 1500 passengers per train at speeds of 250 to 350 mph. While performing many of the same functions of short haul aircraft, these electrically powered vehicles: do not emit pollutants along the route; use about 1/3 the energy per passenger mile of modern aircraft; do not contact the guideway and therefore minimize maintenance; are silent except for the noise of air passing over the body. This paper assesses current maglev technology. DOE

N92-18173# Sandia National Labs., Albuquerque, NM.
LUBRICATION OF FRETTING JOINTS
M. Maillat, H. E. Hintermann, H. Boving, H. R. Kocher, and G. Mondin (Centre National de la Recherche Scientifique, Orleans, France) 1 Oct. 1991 34 p Transl. into ENGLISH from Swiss report, 15 Jan. 1983 p 64-98 Original language document announced as N83-34336
(Contract DE-AC04-76DP-00789)
(DE92-003107; ALS/TR-91-027; ESA-CR(P)-1761) Avail: NTIS HC/MF A03

This report discusses the lubrication of different joints subjected to fretting corrosion. Wear of metal-to-metal, and metal-to-ceramic joints is discussed. DOE

N92-18295# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
SYNTHESIS OF LOCAL CONTROL FOR A ROBOTIC MANIPULATOR JOINT
P. T. L. M. vanWoerkom and G. J. J. Steenman 24 Aug. 1988 149 p Sponsored by Netherlands Agency for Aerospace Programs
(NLR-TR-88142-U; ETN-92-90955) Avail: NTIS HC/MF A07

The synthesis of an algorithm for the automatic control of an electrochemical actuator in the rotational joint of a multilink robotic manipulator is addressed. Control performance is assessed in terms of ability of the control joint to follow a commanded joint angle, or a commanded angular rate. The development and analysis of a mathematical (truth) model suitable for control algorithm synthesis and some exploratory numerical simulations involving continuous time Proportional Derivative (PD) control and discrete time PD control are reported. Synthesis is carried out in the continous time domain. Three control algorithms are described: classical Proportional, Integral, and Derivative (PID) control; redesign of PID control with a model following inner loop; and a redesign based on modern control principles, involving an observer, two feedforward loops, and one feedback loop. Guidelines for parameter-identification are also given. Extensive and systematic simulations are required to determine a definite preference of one of the three control algorithms. Simulation results involving classical control already indicate that even for fairly ideal cases there is a need for control redesign. ESA

N92-18383*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
SUNSPOT: A PROGRAM TO MODEL THE BEHAVIOR OF HYPERVELOCITY IMPACT DAMAGED MULTILAYER INSULATION IN THE SUNSPOT THERMAL VACUUM CHAMBER OF MARSHALL SPACE FLIGHT CENTER
W. K. Rule (Alabama Univ., Tuscaloosa.) and K. B. Hayashida Jan. 1992 50 p
(NASA-TM-103570; NAS 1.15:103570) Avail: NTIS HC/MF A03 CSCL 20K

The development of a computer program to predict the degradation of the insulating capabilities of the multilayer insulation (MLI) blanket of Space Station Freedom due to a hypervelocity impact with a space debris particle is described. A finite difference scheme is used for the calculations. The computer program was written in Microsoft BASIC. Also described is a test program that was undertaken to validate the numerical model. Twelve MLI specimens were impacted at hypervelocities with simulated debris particles using a light gas gun at Marshall Space Flight Center. The impact-damaged MLI specimens were then tested for insulating capability in the space environment of the Sunspot thermal vacuum chamber at MSFC. Two undamaged MLI specimens were also tested for comparison with the test results of the damaged specimens. The numerical model was found to adequately predict behavior of the MLI specimens in the Sunspot chamber. A parameter, called diameter ratio, was developed to relate the nominal MLI impact damage to the apparent (for thermal analysis purposes) impact damage based on the hypervelocity impact conditions of a specimen. Author

N92-18417# National Aerospace Lab., Amsterdam (Netherlands). Space Div.
THE REAL-TIME HERMES ROBOT ARM SIMULATOR: HSF-P
J. J. M. Prins, P. Dieleman, and H. deJong 27 Oct. 1989 11 p Presented at the 2nd European In-Orbit Operations Technology Symposium, Toulouse, France, 12-14 Sep. 1989 Previously announced as N90-24319 Sponsored by Netherlands Agency for Aerospace Programs
(NLR-TP-89331-U; ETN-92-90960) Avail: NTIS HC/MF A03

The Hermes manipulation system to be simulated and the Hermes Robot Arm (HERA) simulation facilities involved are described with focus on the Hermes Simulation Facility Pilot (HSF-P). HERA has to perform tasks ranging from berthing to tool operation in various operational modes from fully automatic to purely manual. The design concept, simulation models, and support tools, as used for HSF-P are discussed. ESA

N92-18494# Israel Atomic Energy Commission, Beersheba. Nuclear Research Center.
WELDING OF ZIRCALLOY-2 AND ZIRCALLOY-4 BY CO2 LASER AND BY TIG M.S. Thesis - Ben Gurion Univ. of the Negev
V. Ram Jan. 1990 77 p In HEBREW; ENGLISH summary
(DE92-604583; NRCN-565) Avail: NTIS HC/MF A05

This study deals with the welding of zircalloy-2 and zircalloy-4 by means of two techniques, namely tungsten inert gas welding and CO2 laser welding. Suitable devices and jigs were developed and manufactured to allow the welding of flat specimens and cylindrical specimens. The optimal welding parameters for the two welding methods were determined. The quality of the welds was determined by tensile strength tests at room temperature and by determining the corrosion resistance to steam at tempratures of 450, 550, and at 650 C. The influence of the weld on the microstructure of the material, on its composition, and its crystallographic structure was investigated. Analysis of fracture surfaces of the tensile specimens was carried out with a scanning electron microscope. DOE

N92-18497# Sandia National Labs., Albuquerque, NM.
DEVELOPMENT OF A HIGH-ACCURACY MOTION COMPENSATION, POINTING, AND STABILIZATION SYSTEM FOR A SYNTHETIC APERTURE RADAR
J. R. Fellerhoff and S. M. Kohler 1991 12 p Proposed for presentation at the 1992 IEEE Position, Location and Navigation Symposium, Monterey, CA, 24-27 Mar. 1992
(Contract DE-AC04-76DP-00789)
(DE92-002361; SAND-91-2303C; CONF-920351-1) Avail: NTIS HC/MF A03

An advanced synthetic Aperture Radar Motion Compensation System has been developed by Sandia National Labs (SNL). The system includes a miniaturized high-accuracy ring laser gyro inertial measurement unit, a three-axis gimbal pointing and stabilization assembly, a differential Global Positioning System (GPS) navigation aiding system, and a pilot guidance system. The system provides unique improvements over previous SNL motion compensation systems and is capable of antenna stabilization to less than 0.01 degrees RMS, absolute antenna velocity measurements to less than 0.1 m/s RMS, and absolute position measurements to less than 5.0 meters RMS. These accuracies have been demonstrated in recent flight testing aboard a DHC-6-300 'Twin Otter' aircraft. DOE

N92-18547# General Electric Co., Schenectady, NY.
ROBOT ARM APPARATUS Patent Application
H. D. Nachbar, inventor (to DOE) 2 Jul. 1990 21 p

(Contract DE-AC12-76SN-00052)
(DE92-003817; US-Patent-Appl-SN-546827;
Patents-US-A7546827) Avail: NTIS HC/MF A03

A robot arm apparatus is provided for inspecting and/or maintaining an interior of a steam generator which has an outside wall and a port for accessing the interior of the steam generator. The robot arm apparatus includes a flexible movable conduit for conveying inspection and/or maintenance apparatus from outside the steam generator to the interior of the steam generator. The flexible conduit has a terminal working end which is translated into and around the interior of the steam generator. Three motors located outside the steam generator are employed for moving the terminal working end inside the steam generator in x, y, and z directions, respectively. Commonly conducted inspection and maintenance operations include visual inspection for damaged areas, water jet lancing for cleaning sludge deposits, core boring for obtaining sludge deposits, and scrubbing of internal parts. DOE

N92-18554# Rockwell International Corp., Golden, CO. Rocky Flats Plant.
SYSTEM AND METHOD FOR EXCHANGING TOOLS AND END EFFECTORS ON A ROBOT Patent Application
D. B. Burry, inventor (to DOE) and P. M. Williams, inventor (to DOE) 2 Apr. 1990 29 p
(Contract DE-AC34-90DP-62349)
(DE92-003836; US-Patent-Appl-SN-502962;
Patents-US-A7502962) Avail: NTIS HC/MF A03

This invention is comprised of a system and method for exchanging tools and effectors on a robot which permits exchange during a programmed task. The exchange mechanism is located off the robot, thus, reducing the mass of the robot arm and permitting smaller robots to perform designated tasks. A simple spring/collet mechanism mounted on the robot is used which permits the engagement and disengagement of the tool or end effector without the need for a rotational orientation of the tool to the end effector/collet interface. Since the tool changing system is not located on the robot arm, no umbilical cords are located on the robot. DOE

N92-18567# Los Alamos National Lab., NM.
AUTOMATIC FEED SYSTEM FOR ULTRASONIC MACHINING Patent Application
N. C. Calkins, inventor (to DOE) 11 May 1990 12 p
(Contract W-7405-eng-36)
(DE92-004614; US-Patent-Appl-SN-522016;
Patents-US-A7522016) Avail: NTIS HC/MF A03

This invention is comprised of a method and apparatus for ultrasonic machining in which feeding of a tool assembly holding a machining tool toward a workpiece is accomplished automatically. In ultrasonic machining, a tool located just above a workpiece and vibrating in a vertical direction imparts vertical movement to particles of abrasive material which then remove material from the workpiece. The tool does not contact the workpiece. Apparatus for moving the tool assembly vertically is provided such that it operates with a relatively small amount of friction. Adjustable counterbalance means is provided which allows the tool to be immobilized in its vertical travel. A downward force, termed overbalance force, is applied to the tool assembly. The overbalance force causes the tool to move toward the workpiece as the material is removed from the workpiece. DOE

N92-18603# Lawrence Livermore National Lab., CA.
HARDENING AUTOMATED EQUIPMENT FOR HOSTILE ENVIRONMENTS
D. C. Allen, M. Hayward, R. H. Sievers, and L. Cook Nov. 1991 13 p Presented at the Winter Meeting of the American Nuclear Society (ANS), San Francisco, CA, 10-15 Nov. 1991
(Contract W-7405-eng-48)
(DE92-004669; UCRL-JC-108735; CONF-911107-48) Avail: NTIS HC/MF A03

Lawrence Livermore National Laboratory (LLNL) is developing robotic systems suited to replacing human operations involving the processing of radioactive materials within glove boxes. The glove box enclosures contain a variety of hostile environmental factors that are deleterious to standard commercial robotic components. In addition to the high alpha activity encountered inside the enclosure, the equipment is expected to operate in dusty conditions with a high hardness dust. The gaseous environments include very low concentrations of oxygen and moisture within an inert nitrogen or argon fill. The radiation and the other environmental factors can be hostile to electronics, electrical-mechanical systems, and the materials of which they are composed. The developmental robotic system incorporates materials and components especially selected for improved resistance to these environments. A small commercial overhead gantry robot, the IBM electrical cantilevered robot, was modified and hardened for plutonium processing applications in a glove box. The robotic components are being tested for survivability by operating in a sealed glove box and by testing selected items separately. The results of the developmental effort are projected to be generic and suited to a wide range of DOE special nuclear material processing and system production applications. DOE

N92-18687# Kansas State Univ., Manhattan. Coll. of Engineering.
KANSAS STATE UNIVERSITY ELECTRIC VEHICLE SITE OPERATOR PROGRAM
J. R. Hague, R. A. Steinert, and T. Nissen-Pfrang 1991 13 p
(Contract DE-FC07-91ID-13074)
(DE92-004326; DOE/ID-13074/T1) Avail: NTIS HC/MF A03

During the past fifteen years Kansas State's faculty has been involved in research of alternative fuel vehicles. From formulation of fuels and automotive fuel storage to development of electronic controls, K-State's faculty research has been ongoing. With the increased awareness of what is occurring to the world's environment, the catalyst (to ensure applied results from faculty research will occur) has been activated. The Department of Energy's Electric Vehicle Site Operator Program is the platform being used to demonstrate international efforts to bring a more acceptable daily mode of transportation to our highways. The first new electrical vehicle procured at K-State in the last ten years, a G-Van, is a technological dinosaur. It does not incorporate leading edge control or drive systems nor does it provide the type of vehicle frame and body to meet a majority of the daily commuter needs required by the American market. Yet, this vehicle represents initial efforts to bring a federally crash certified vehicle to the commercial automotive market. As such, it is an evolutionary step in the mass production of electric vehicle products. DOE

N92-18704# Westinghouse Idaho Nuclear Co., Inc., Idaho Falls.
VALVE STEM AND PACKING ASSEMBLY Patent Application
J. J. Wordin, inventor (to DOE) 31 May 1990 19 p
(Contract DE-AC07-84ID-12435)
(DE92-003777; US-Patent-Appl-SN-531487;
Patents-US-A7531487) Avail: NTIS HC/MF A03

A valve stem and packing assembly is provided in which a rotatable valve stem includes a first tractrix surface for sliding contact with a stem packing and also includes a second tractrix surface for sliding contact with a bonnet. Force is applied by means of a spring, gland flange, and gland on the stem packing so the stem packing seals to the valve stem and bonnet. This configuration serves to create and maintain a reliable seal between the stem packing and the valve stem. The bonnet includes a second complementary tractrix surface for contacting the second sliding tractrix surface, the combination serving as a journal bearing for the entire valve stem and packing assembly. The journal bearing so configured is known as a Schiele's pivot. The Schiele's pivot also serves to maintain proper alignment of the valve stem with respect to the bonnet. Vertical wear between the surfaces of the Schiele's pivot is uniform at all points of contact between the second sliding tractrix surface and the second complementary tractrix surface of a bonnet. The valve stem is connected to a valve plug by means of a slip joint. The valve is opened and closed by rotating the valve stem. The slip joint compensates for wear on the Schiele's pivot and on the valve plug. A ledge is

provided on the valve bonnet for the retaining nut to bear against. The ledge prevents overtightening of the retaining nut and the resulting excessive friction between stem and stem packing. DOE

N92-18850# General Atomic Co., San Diego, CA.
OPTIMIZATION OF THERMAL DESIGN FOR NITROGEN SHIELD OF JET CRYOPUMP
C. B. Baxi and W. Obert Nov. 1991 4 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-004295; GA-A-20587; CONF-910968-50) Avail: NTIS HC/MF A01

The reference design of JET cryopump nitrogen shield consists of an outer section made of copper chevrons fastened to two cooling tubes and an inner stainless steel section and backing plate with two cooling tubes. These tubes are fed in a parallel flow arrangement. The inlet flow is divided into two parallel paths so that both tubes on either section are always at the same temperature. This arrangement was selected due to concern about conduction between warm and cold parts of the shield during cooldown transients. If the heat loads are unequal, such a parallel flow arrangement can result in flow starvation in the path with higher heat load. This will cause large temperature differences and, ultimately, structural failure. Hence, an analysis was undertaken to investigate the conduction effects in the shield for other flow arrangements. DOE

N92-18915# Centre de Recherches Scientifiques et Techniques de l'Industrie des Fabrications Metalliques, Brussels (Belgium). Section Construction Metallique.
HIGH RESISTANCE 10.9 QUALITY BOLTS: RESEARCH INTO THE OPTIMUM MIXED TIGHTENING CONDITIONS [BOULONS A HAUTE RESISTANCE DE QUALITE 10.9: RECHERCHE DES CONDITIONS OPTIMALES POUR LE SERRAGE MIXTE]
J. P. Degueldre, E. Dehan, and E. Piraprez Dec. 1990 96 p In FRENCH
(CRIF-MT-179; ETN-92-90665) Avail: NTIS HC/MF A05

The need to carry out high tightening of assemblies has led to recommendations to tighten bolts beyond the elastic limits of the metal used to make the bolts. The effects in the bolt and the threads, and the subsequent failure modes that might occur are to date unknown. The behavior of bolts up to the maximum limit of tightening is studied. Ways to improve their behavior through the use of harder bolts and lubricants designed to reduce torsion stress are described. The use of mixed tightening regimes following the EUROCODE 3 recommendations on high resistance and well lubricated bolts allows high tightening levels to be reached with little bolt damage. ESA

38 QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

N92-18298*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, FL.
TOTAL QUALITY LEADERSHIP Summary Report
Apr. 1991 182 p Presented at the 7th Annual NASA/Contractors Conference on Quality and Productivity p 24-25 Oct. 1990
(NASA-TM-105466; NAS 1.15:105466; ISSN-1049-667X) Avail: NTIS HC/MF A09 CSCL 05A

More than 750 NASA, government, contractor, and academic representatives attended the Seventh Annual NASA/Contractors Conference on Quality and Productivity. The panel presentations and Keynote speeches revolving around the theme of total quality leadership provided a solid base of understanding of the importance, benefits, and principles of total quality management (TQM). The presentations from the conference are summarized. Author

N92-18332# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsion Systems.
LONG TERM FAILURE MECHANISMS AND RELIABILITY RISKS IN EEE COMPONENTS FOR SPACE APPLICATION
Rolf Rieger 1990 6 p Presented at the 7th International Conference on Reliability and Maintainability, Brest, France, 18-22 Jun. 1990
(MBB-UK-0099-90-PUB; ETN-92-90613) Avail: NTIS HC/MF A02

Several examples of mission critical component failures are described. These failures result from typical long term failure modes not detectable by means of the screening and acceptance procedures presently in use. One category of these failure modes is related to moisture trapped within hermetically sealed packages. The other results from insufficient hermeticity. The moisture problem is not covered by the ESA/SCC specification system to date. The U.S. MIL-STD system provides rules for monolithic and hybrid microcircuits but not for discrete semiconductors. ESA

N92-18370*# National Aeronautics and Space Administration, Washington, DC.
GEORGE M. LOW TROPHY: NASA'S QUALITY AND EXCELLENCE AWARD
Jul. 1991 32 p Prepared in cooperation with American Society for Quality Control, Milwaukee, WI
(NASA-TM-105469; NAS 1.15:105469) Avail: NTIS HC/MF A03; 7 functional color pages CSCL 05A

NASA's major goal is the preservation of America's position as a leader in the aerospace industry. To maintain that status, it is crucial that the products and services we depend upon from NASA contractors, subcontractors, and suppliers meet the highest quality standards to ensure the space program's success. The George M. Low Trophy: NASA's Quality and Excellence Award is the result of NASA's desire to encourage continuous improvement and Total Quality Management (TQM) in the aerospace industry and is awarded to members of NASA's contractor community that have demonstrated sustained excellence, customer orientation, and outstanding achievements in a Total Quality Management (TQM) environment. The purpose in presenting this award is to increase public awareness of the importance of quality and productivity to the nation's aerospace industry and the nation's leadership position overall; encourage domestic business to continuously pursue efforts that enhance quality and increase productivity which will strengthen the nation's competitiveness in the international arena; and provide a forum for sharing the successful techniques and strategies used by applicants with other American organizations. Awards to Rockwell International and Marotta Scientific Controls, Inc. are announced and discussed. Author

N92-18380# Institute of Nuclear Physics, Krakow (Poland).
MEASUREMENT STAND FOR DIAGNOSIS OF SEMICONDUCTOR DETECTORS BASED ON IBM PC/XT COMPUTER (4-WAY SPECTROMETRIC ANALYSIS OF PULSES)
M. Gruszecki 1990 61 p In POLISH; ENGLISH summary
(DE92-605637; INP-1490/E) Avail: NTIS HC/MF A04

The technical assumptions and partial realization of our technological stand for quality inspection of semiconductor detectors for ionizing radiation manufactured in the INP in Cracow are described. To increase the efficiency of the measurements, simultaneous checking of 4 semiconductor chips or finished products is suggested. In order to justify this measurement technique a review of possible variants of the measurement apparatus is presented for the systems consisting of home made units. Comparative parameters for the component modules and for complete measuring systems are given. The construction and operation of data acquisition system based on IBM PC/XT are described. The system ensures simultaneous registration of pulses obtained from 4 detectors with maximal rate of up to 500 x 10(exp 3) pulse/s. DOE

N92-18515# Vatell Corp., Blacksburg, VA.
EDDY CURRENT TRANSDUCING SYSTEM
13 Sep. 1991 77 p
(Contract DE-FG01-89CE-15426)
(DE91-018924; DOE/CE-15426/T9) Avail: NTIS HC/MF A05

In a program funded by the Office of Energy Related Inventions of the Department of Energy, Vatell Corporation developed a prototype Turbine Blade Condition Monitor. This microcomputer-based system was tested to determine its performance in measuring individual blade clearance and time of arrival on a Pratt & Whitney (Canada) JT15D jet engine. A Vatell eddy current sensor mounted in the housing of the engine at mid-chord of the N1 first stage provided the signals. The N1 first stage is a 31 in. diameter fan with 28 titanium blades, operating over a speed range of approximately 7000 to 14,000 rpm. Tests showed that the monitoring system transduced blade clearances with a precision of .0001 in., simultaneously indicating times of arrival within 0.1 microseconds, equivalent to a pitch of .0015 in. Patterns of blade clearances and timing variations were observed for various engine operating conditions, and the clearance and time of arrival 'signatures' of the fan stage were recorded. Manufacturing variations in blade pitch were readily detected, as were indications of blade and hub vibration. The report contains a detailed description of the development program, examples of waveforms and recorded data, circuit diagrams, software, setup, and operating procedures for the monitoring system. DOE

N92-19004# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Structures and Materials Panel.
AGARD/SMP REVIEW: DAMAGE TOLERANCE FOR ENGINE STRUCTURES. 4: RELIABILITY AND QUALITY ASSURANCE
Dec. 1991 42 p In ENGLISH and FRENCH The 69th meeting was held in Brussels, Belgium, 1-6 Oct. 1989
(AGARD-R-773; ISBN-92-835-0648-0) Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The workshop reviewed the areas critical to the acceptance of an approach based on damage tolerance concepts as an alternative service life philosophy to that of 'safe life' for the design of engine components. Also addressed was the need for, and the approaches to, ensuring component reliability and quality assurance. The current procedures were surveyed for materials and component specifications, standard process control, quality assurance, and systems design. For individual titles, see N92-19005 through N92-19007.

N92-19005# Rolls-Royce Ltd., Derby (England).
INTRODUCTION: NEEDS AND APPROACHES TO RELIABILITY AND QUALITY ASSURANCE IN DESIGN AND MANUFACTURE
A. C. Pickard *In* AGARD, AGARD/SMP Review: Damage Tolerance for Engine Structures. 4: Reliability and Quality Assurance Dec. 1991 4 p Previously announced as N91-10297 (For primary document see N92-19004 09-38)
Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In the damage tolerance approach for improving the integrity of aircraft engines, reliability and quality assurance issues are discussed. The implications of the following aspects on the damage tolerance concept are studied: component material specifications and standards; controls on manufacturing processes and procedures; and design systems and quality assurance. The subjects reviewed in the workshop on reliability and quality assurance are given. Author

N92-19006# Societe Nationale d'Etude et de Construction de Moteurs d'Aviation, Evry Cedex (France).
MANUFACTURING PROCESS CONTROL AS A DAMAGE TOLERANCE CONCEPT
Jean-Paul Herteman *In* AGARD, AGARD/SMP Review: Damage Tolerance for Engine Structures. 4: Reliability and Quality Assurance Dec. 1991 7 p (For primary document see N92-19004 09-38)
Copyright Avail: NTIS HC/MF A03; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Manufacturing process control means a search for the lowest possible variability of the manufacturing part characteristics. Process control is as necessary for damage tolerance as for a conventional 'safe service life' design, or even more, for reasons relating to the engine reliability and operation safety on the one hand and to the life cycle costs on the other hand. These reasons are reviewed. Furthermore, damage tolerance contains several concepts which can be used profitably to modify, reorientate, and improve the procedures giving access to the required process control. Some of these concepts are discussed. Author

N92-19007# Fiat Aviazione S.p.A., Turin (Italy).
QUALITY ASSURANCE AND DESIGN SYSTEMS
L. Caroni and E. Campo *In* AGARD, AGARD/SMP Review: Damage Tolerance for Engine Structures. 4: Reliability and Quality Assurance Dec. 1991 9 p (For primary document see N92-19004 09-38)
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Inside the company quality system as outlined by NATO AQAP-1, a major role is given to engineering quality. This is the branch which is responsible for assurance that a design and development program is set, codes of design practice are established and maintained, and that drawings and specifications include all practical experience gained by the company. The engineering quality manual and the design manual are the reference for such activities. The engineering quality manual, in fact, sets the methodology to be used in the project development. The design manual, on the other hand, documents the technical data and information to support material choice, structural analysis, and life prediction. An example is given to show the type of content of the design manual within the subject of damage tolerance criteria of rotating critical parts. Author

N92-18608# Eurospace, Paris (France).
INTERNATIONAL COLLABORATION IN PA AND SAFETY, THE EUROSPACE PA-PANEL
J. Levold (Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen, Germany, F.R.) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 5-8 (For primary document see N92-18607 09-31)
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N92-18610# Alcatel Espace, Toulouse (France).
ESA PSS AND SCC SPECIFICATIONS IN NON ESA PROGRAMMES
J. L. Septfonds *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 17-19 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18611# Indian Space Research Organization, Bangalore. Satellite Centre.
SPACE PRODUCT ASSURANCE MANAGEMENT STRATEGIES FOR THE 1990S
K. R. Ramgopal *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 21-25 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18612# Fabrica Italiana Apparecchiature Radioelettriche S.p.A., Milan.
IMPROVING COST/EFFICIENCY: HOW WE ACT IN PRACTICE
F. Ciotola and S. Ronchi *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 27-33 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18613# Alenia, Torino (Italy).
PRODUCT ASSURANCE APPROACH FOR FUTURE SPACE PROJECTS

Giovanni Surbone and Marcello Scolaris *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 35-42 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18615# Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (Germany, F.R.). Space Communications and Propulsion Systems.
CONSIDERATION OF LEGAL ASPECTS VERSUS MANAGERIAL NEEDS OF PROCUREMENT ASSURANCE
Wolf-Dieter Pilz *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 51-55 (For primary document see N92-18607 09-31)
(MBB-UK-0137-91-PUB; OTN-033133) Copyright Avail: NTIS HC/MF A13

N92-18617*# National Aeronautics and Space Administration, Washington, DC.
NASA PRODUCT ASSURANCE IN THE 1990S
George A. Rodney and James H. Ehl *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 61-65 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13 CSCL 14D

N92-18620# Societe Europeenne de Propulsion, Vernon (France).
PRODUCT ASSURANCE AND QUALITY [ASSURANCE PRODUIT ET QUALITE DU SYSTEME INDUSTRIEL]
R. Heidmann and R. Vogin *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 79-83 In FRENCH (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18621# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Product Assurance Support.
ORGANIZATIONAL ASPECTS FOR PREVENTING HUMAN FAULTS IN SPACE SYSTEMS: SYSTEMS ENGINEERING APPROACHES TO TOTAL QUALITY MANAGEMENT
Hans Joerg Keller *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 85-90 (For primary document see N92-18607 09-31)
(MBB-UK-0139-91-PUB; OTN-033147) Copyright Avail: NTIS HC/MF A13

N92-18622# Aerospatiale, Cannes (France).
QUALITY-COMPLEXITY-COMPETITIVITY TOWARDS IMPROVED INTEGRATION OF PRODUCT ASSURANCE
J. Germain and J. L. Douliery *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 91-94 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18625# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
SOFTWARE PRODUCT ASSURANCE: CURRENT SITUATION AND FUTURE TRENDS WITHIN EUROPE SPACE ACTIVITIES
H. Norrenbrock *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 109-114 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18626# Canadian Space Agency, Ottawa (Ontario).
CANADIAN SPACE STATION SOFTWARE PRODUCT ASSURANCE PROGRAM
Richard Storm and Michael Evans (Computers and Concepts Associates, Ontario) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 115-120 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18627# Aerosystems International, Yeovil (England).
SOFTWARE DEPENDABILITY ASSESSMENT
P. L. Helyer and M. M. Burke *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 121-126 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18628*# National Aeronautics and Space Administration, Washington, DC.
PRODUCT ASSURANCE MANAGEMENT AND SOFTWARE PRODUCT ASSURANCE
C. Schneider, G. Borycki, P. Panaroni, M. Surbone, R. Borcz, and A. J. Beddow (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 129-131 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18629# Technical Research Centre of Finland, Tampere. Safety Engineering Lab.
QUALITY ASSURANCE OF SAFETY AND RISK ANALYSIS
V. Rouhiainen and J. Suokas *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 135-140 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18632# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
PRODUCT ASSURANCE AND SAFETY IMPLEMENTATION ON SPACE SHUTTLE PAYLOADS: AN INDUSTRIAL PERSPECTIVE
Ian Jenkins *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 153-158 (For primary document see N92-18607 09-31)
(MBB-UK-0143-PUB; OTN-033151) Copyright Avail: NTIS HC/MF A13

N92-18633# European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk (Netherlands).
RELIABILITY MODELING FOR NON-ELECTRONIC SYSTEMS
N. Valisena and T. deMollerat (Aerospatiale, Cannes, France) *In its* Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 159-163 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18638# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Space Communications and Propulsions Div.
CONSTRAINTS AND DIFFICULTIES IN IMPLEMENTATION OF RAMS ASSURANCE PROGRAMMES
Miodrag Culjkovic *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 185-187 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18639# Technische Univ., Delft (Netherlands).
RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND SAFETY Abstract Only
A. Hale, G. L. Roth, M. Culjkovic, P. Charron, and K. Wright (European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands) *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 191 (For primary document see N92-18607 09-31)
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N92-18641# British Aerospace Public Ltd. Co., Stevenage (England). Communications Satellite Div.
PRODUCT ASSURANCE: MOVING TOWARDS TOTAL QUALITY
Stan Wilson *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 203-206 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18642# Telesat Canada, Ottawa (Ontario).
SPACE PRODUCT ASSURANCE FOR THE 90'S: IN TRANSITION OR DECLINE?
Sean Paul Silke *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 207-211 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18645# Alenia, Torino (Italy).
A PRODUCT ASSURANCE ENGINEERING CONCEPT FOR COMPLEX SPACE SYSTEMS
Mario Ferrante and Danilo Foltran *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 229-236 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18648# Exeter Univ. (England). School of Engineering.
RELIABILITY MODELING OF THE SYSTEMS WHOSE COMPONENTS HAVE NON-CONSTANT FAILURE RATE
J. Knezevic *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 249-252 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18651# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
COLLECTION OF PRODUCT ASSURANCE DATA AND THEIR EFFECTIVE UTILIZATION
L. Haupt *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 267-272 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18654# Erno Raumfahrttechnik G.m.b.H. Bremen (Germany, F.R.).
RELIABILITY AND SAFETY ANALYSES OF SYSTEMS USING PETRI NETS
Juergen Arndt *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 283-288 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18656# Mirespace, Orleans (France).
MARTA: METHODS FOR ANALYTICAL RELIABILITY AND TEST ASSESSMENT: A SOFTWARE TOOL FOR RELIABILITY CALCULATION OF COMPLEX SYSTEMS
J. P. Baudet and S. Bianchi *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 293-296 Prepared in cooperation with ESA, Paris, France (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

39 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress.

For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance.*

N92-18053*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
EFFECT OF CRASH PULSE SHAPE ON SEAT STROKE REQUIREMENTS FOR LIMITING LOADS ON OCCUPANTS OF AIRCRAFT
Huey D. Carden Washington Feb. 1992 23 p
(NASA-TP-3126; L-16941; NAS 1.60:3126) Avail: NTIS HC/MF A03 CSCL 20K

An analytical study was made to provide comparative information on various crash pulse shapes that potentially could be used to test seats under conditions included in Federal Regulations Part 23 Paragraph 23.562(b)(1) for dynamic testing of general aviation seats, show the effects that crash pulse shape can have on the seat stroke requirements necessary to maintain a specified limit loading on the seat/occupant during crash pulse loadings, compare results from certain analytical model pulses with approximations of actual crash pulses, and compare analytical seat results with experimental airplace crash data. Structural and seat/occupant displacement equations in terms of the maximum deceleration, velocity change, limit seat pan load, and pulse time for five potentially useful pulse shapes were derived; from these, analytical seat stroke data were obtained for conditions as specified in Federal Regulations Part 23 Paragraph 23.562(b)(1) for dynamic testing of general aviation seats. Author

N92-18062# Lawrence Livermore National Lab., CA.
IMPLEMENTATION OF THE J-INTEGRAL OPTION IN NIKE2D
E. Zywicz 1 Jul. 1991 28 p
(Contract W-7405-eng-48)
(DE92-004625; UCRL-ID-108596) Avail: NTIS HC/MF A03

Numerical procedures have been incorporated into the finite-deformation finite element (FE) code NIKE2D to extract fracture mechanics parameters directly from the equilibrium solution. The domain integral implementation permits the energy release rate, as measured by the J-Integral to be evaluated under static states from general (non-isothermal) conditions and for restricted thermal conditions. Thermal J extractions are limited to material systems which posses a linearly elastic dilatational response. A mode mixing separation technique, based upon energy interaction integrals, is implemented for planar geometries and permits the mode 1 and 2 components of the static stress intensity factors to be calculated for both homogeneous isotropic elastic and isotropic elastic interfacial cracks. The small-strain mode separation method includes an optional compensator which accounts for large rigid-body crack-tip rotations. User input is minimized because the implementation automatically determines the integration domains from the user specified crack-tip nodes. Several example problems demonstrate the various features and overall accuracies. DOE

N92-18079# Army Armament Research, Development and Engineering Center, Watervliet, NY.
ELASTIC-PLASTIC ANALYSIS OF A STEEL PRESSURE VESSEL WRAPPED WITH MULTILAYERED COMPOSITES Final Report
Peter C. Chen Oct. 1991 26 p
(AD-A243420; ARCCB-TR-91031) Avail: NTIS HC/MF A03 CSCL 13/10

An elastic-plastic analysis of stresses and strains in an internally pressurized, composite-jacketed cylinder is presented. Each layer is orthotropic but with different material properties. Analytical expressions are derived for a steel pressure vessel wrapped with multilayered composites. Numerical results are obtained for three types of composite jackets. The interface pressure, hoop strains, and stresses in the liner and jacket are presented. GRA

N92-18082 ESDU International Ltd., London (England).
STRUCTURAL PARAMETERS USED IN RESPONSE CALCULATIONS: ESTIMATION OF NUMERICAL VALUES
Dec. 1991 32 p
(ESDU-91001; ISBN-0-85679-763-4; ISSN-0143-2702) Avail: ESDU

Background information and guidance is given on the values for various quantities needed in calculating the response of flexible structures. Axes systems used are defined and the equation of motion for a single mode in translational or rotational vibration is stated. Likely inaccuracies to be met in estimated or full-scale measured values of natural frequency, structural damping and generalized mass are suggested. Natural frequencies are given for the first four modes of vibration of single- and multi-span beams and the simple equations for the frequency of the fundamental mode of vibration of a tall building is given, with an indication of the likely error. A similar equation is also provided for stacks, towers and columns. Treatment of additional masses and non-uniform mass is considered. Mode shape functions are

provided for cantilever and single- and two-span structures in various translational modes, for single-support structures in rotation about the support, and for a cantilever in the first torsional mode. Typical values of structural damping are tabulated for stacks, towers, and tubes. Equations of mode-generalized mass and inertia are stated, and generalized masses in bending are listed for buildings and single-span beams. Typical ranges of structural density are shown graphically for stacks, and stated for buildings, and a table gives area and moment of area for a wide range of section shapes. ESDU

N92-18091 ESDU International Ltd., London (England).
RESPONSE OF STRUCTURES TO GALLOPING EXCITATION: BACKGROUND AND APPROXIMATE ESTIMATION
Dec. 1991 24 p
(ESDU-91010; ISBN-0-85679-772-3; ISSN-0141-2702) Avail: ESDU

Described here is the mechanism of galloping, an aeroelastic response in which changes in wind load due to structure response are in-phase with the structure velocity. The concepts of soft and hard oscillators are introduced and explained, and the possibilities of across-wind, along-wind and torsional galloping are discussed. Stall galloping, wake galloping, and flutter as separate mechanisms are defined and briefly described. A method is provided for estimating the wind speed for the onset of galloping (or the structural damping required to prevent galloping at a given wind speed) for a single degree of freedom system. A technique of approximately determining the galloping onset wind speed and the maximum amplitude is suggested for force coefficient curves typical of sharp-edged sections. Typical results for onset wind speed and response are shown for typical force curves. The theoretical approach used is fully explained and a worked example illustrates its use. Methods of reducing or eliminating galloping are outlined briefly. ESDU

N92-18115# Wichita State Univ., KS. National Inst. for Aviation Research.
IMPACT RESPONSE OF LAMINATED PLATES SUBJECTED TO TRANSVERSE LOADING
G. H. Choe and J. Chaudhuri Dec. 1991 29 p
(NIAR-91-29) Avail: NTIS HC/MF A03

An analytical solution for laminated plates subjected to transverse impact loading is presented. The solution uses a fundamental natural frequency approach to obtain the effective bending-shear stiffness. This stiffness is proposed to predict the maximum impact force at the energy-balance model. The analysis agrees well with experimental data at low velocities. The results could be used in conjunction with ultrasonic C-scan to characterize the impact damage resistance. Author

N92-18175# Lawrence Livermore National Lab., CA.
REDIRECTION OF DYNAMIC COMPRESSIVE WAVES IN MATERIALS WITH NEARLY ORTHOGONAL AND RANDOM JOINT SETS
O. R. Walton, D. M. Maddix, T. R. Butkovich, and F. E. Heuze Mar. 1991 11 p Presented at the Recent Advances on Mechanics of Structure Continua American Society of Mechanical Engineers (ASME) Applied Mechanics Conference, Columbus, OH, 16-19 Jun. 1991
(Contract W-7405-eng-48)
(DE92-003700; UCRL-JC-106751; CONF-9106120-2) Avail: NTIS HC/MF A03

Two-dimensional discrete-particle (i.e., distinct-element) calculations demonstrate the redirection of particle velocity vectors emanating from a rapidly loaded region such as an explosively loaded borehole or tunnel. Previous simulations have demonstrated redirection of particle motions in randomly fractured media when significant shearing displacements result in dilatancy. This work shows redirection in media with nearly regular and nearly orthogonal joint sets, resulting in asymmetric radiation patterns, even for situations with quite small displacements. Random joint sets (simulated with Voronoi polygons) on the other hand, do not exhibit significant redirection of emanating signals unless significant shear displacements occur. Such redirection could account for anisotropic seismic radiation patterns observed around deeply buried explosions in hard rock. Variation of contact parameters and joint models in these simulations serves to demonstrate that the joint pattern and block kinematics are the dominant mechanisms contributing to this redirection of the compressive waves. DOE

N92-18248# Polish Academy of Sciences, Warsaw. Dept. of the Mechanics of Continuous Media.
A MORE FUNDAMENTAL APPROACH TO THE INTERPRETATION OF PHOTOELASTIC DATA
Wojciech Szczepinski 1991 36 p
(ISSN-0208-5658) Avail: NTIS HC/MF A03

In standard photoelasticity, changes in thickness of the model caused by external loading are usually neglected. In most practical cases such an approach is fully justified because the effects of change in thickness are small. However, in some cases when the material used for the model has a small Young's modulus or when the stress concentrations in the model are very large, these second order effects should be taken into account. Certain numerical methods are proposed allowing the inclusion of these second order effects into the procedure of interpreting photoelastic data. Similar numerical methods are also proposed allowing interpretation of the photoelastic data for models of machine parts with moderately varying thickness. Proposed calculation techniques are based on the method of characteristics, because in most cases problems of interpreting photoelastic data reduce to the integration of quasilinear partial differential equations of the hyperbolic type. Author

N92-18283# Polish Academy of Sciences, Warsaw. Inst. Podstawowych Problemow Techniki.
METHODOLOGY OF STRENGTH DESIGN OF STRUCTURAL ELEMENTS ACCORDING TO THE LIMIT LOAD CARRYING CAPACITY CRITERION
Jan Szlagowski (Technical Univ. of Warsaw, Poland) 3 Sep. 1990 203 p In POLISH; ENGLISH summary
(ISSN-0208-5658) Avail: NTIS HC/MF A10

A compact computerized methodology for shaping diverse structural elements according to the method of statically admissible discontinuous stress fields is presented. A package of separate utility programs for solving the selected systems of stress discontinuity lines has been prepared. The solutions have been found for four limit state conditions, i.e., Tresca, Huber-Mises, Coulomb-Mohr and parabolic conditions. Further, an algorithm has been developed and the O.K.SDNPN program has been created which automatically combines various stress fields in a statically admissible way. The work encloses a number of examples of automatic shaping of a hydraulic ram joint, some compact structure elements (13), structural steel joints and plate girder structures. The work greatly broadens the scope of practical applications of the method, in particular with the analysis of soil and rock mechanics (e.g., crushing processes). These possibilities have been only mentioned by giving an example of cutting a rock block and of shaping a concrete post footing. The prepared software package allowed for a considerable speed-up of the design process and, for the first time, the possibility emerged to strictly and efficiently connect the statically admissible discontinuous stress fields method with the finite elements method and computer aided design programs. The O.K.SDNPN provides for easy extension of the library of fields and can be used for materials exhibiting orthotropic properties (e.g., steel reinforced concrete). The subsequent step should be the development of a program for automatic generation of statically admissible stress fields. Author

N92-18284# Polish Academy of Sciences, Warsaw. Inst. Podstawowych Problemow Techniki.
DISCRETE OPTIMIZATION OF TRUSS STRUCTURES UNDER LOSS OF STABILITY CONSTRAINTS
Mariusz Pyrz 1990 133 p In POLISH; ENGLISH summary
(ISSN-0208-5658) Avail: NTIS HC/MF A07

Discussed here are problems of discrete optimization of elastic truss structures with loss of stability constraints. The problem under

consideration consists of minimizing the weight of the bars under constraints on element stresses, element stability and global structural stability. Design variables are areas and moments of inertia of members' cross sections, selected from discrete, finite catalogues. An enumeration method according to the increasing value of the objective function is applied. Shallow truss structures with nonlinear geometrical behavior and regular frame structures under the assumption of small displacements in undercritical state are considered. In numerical examples of shallow trusses, the influence of stiffness zones on discrete solutions has been investigated. The discrete optimal solutions have been compared with the results of continuous design variables optimization as well as optimal solutions obtained for nonlinear and linearized stability analysis. A method of optimal members estimation has been found, the influence of small initial imperfections of geometry on discrete optimal designs has been examined. The critical loads were calculated from the minimum potential energy condition. In numerical examples of regular frames, optimization discrete solutions have been analyzed for different cross-sectional catalogues. The finite differences calculus and estimation of instability modes method were used to obtain critical loads.

Author

N92-18485# National Aerospace Lab., Tokyo (Japan). Airframe Div.

VIBRATION TESTS OF LONG PLATE STRUCTURAL MODEL [OBIITA KOZO MOKEI NO SHINDO SHIKEN]

Yasukatsu Ando, Masakatsu Minegishi, Yuji Matsuzaki, and Kunio Kumakura Jul. 1990 33 p In JAPANESE

(NAL-TM-625; ISSN-0452-2982; JTN-92-80293) Avail: NTIS HC/MF A03

In order to establish a test method of the sine wave multipoint forced oscillation test, the vibration test using the multipoint forced oscillation analysis system of the vibration test facility was performed. As the analysis method, the normal mode method (MODAP) and the transfer function method by forced oscillation (MODAT SINE) were adopted. As the test model in the test, long plate structure mode was made. As a result of the test, technical experience of the vibration test using large structures was accumulated and problems to be solved in the future were identified. Author (NASDA)

N92-18486# International Centre for Theoretical Physics, Trieste (Italy).

MODELING OF MULTIBRANCHED CROSSLIKE CRACK GROWTH

E. Canessa and B. Tanatar Jun. 1991 30 p

(DE92-609236; IC-91/138) Avail: NTIS HC/MF A03

Multibranched crosslike crack patterns formed in concentrically loaded square plates are studied in terms of fractal geometry, where the associated fractal dimension d(sub f) is calculated for their characterization. We apply simplest deterministic and stochastic approaches at a phenomenological level in an attempt to find generic features as guidelines for future experimental and theoretical work. The deterministic model for fracture propagation that is applied, which is a variant of the discretized Laplace approach for randomly ramified fractal cracks, reproduces the basic ingredients of observed complex fracture patterns. The stochastic model, although not strictly a model for crack propagation, is based on diffusion-limited aggregation (DLA) for fractal growth and produces a slightly more realistic assessment of the crosslike growth of the cracks in asymmetric multibranches. Nevertheless, this simple ad-hoc DLA version for modeling the present phenomena as well as the deterministic approach for fracture propagation give fractal dimensionality for the fracture pattern in accord with our estimations made from recent experimental data. It is found that there is a crossover of two fractal dimensions, corresponding to the core (higher d(sub f)) and multibranched crosslike (lower d(sub f)) regions, that contain loops, that are interpreted as representing different symmetry regions within the square plates of finite size. DOE

N92-18487# International Centre for Theoretical Physics, Trieste (Italy).

FRACTAL DESCRIPTION OF FRACTURES

C. W. Lung Jun. 1991 11 p

(DE92-609237; IC-91/148) Avail: NTIS HC/MF A03

Recent studies on the fractal description of fractures are reviewed. Some problems in this area are discussed. It seems hopeful to use the fractal dimension as a parameter for quantitative fractography and to apply fractal structures to the development of high toughness materials. DOE

N92-18564# Battelle Columbus Labs., OH.

AN INVESTIGATION OF THE EFFECTS OF HISTORY DEPENDENT DAMAGE IN TIME DEPENDENT FRACTURE MECHANICS. PHASE 1: CONSTANT LOAD CONDITIONS

F. W. Brust, P. Krishnaswamy, and N. D. Ghadiali 14 Nov. 1991 51 p

(Contract DE-FG02-90ER-14135)

(DE92-004428; DOE/ER-14135/T1) Avail: NTIS HC/MF A04

In the following section, a brief review of constitutive models is presented along with the implications of using them in creep crack growth studies under variable loads. The model selected for this study is discussed along with its special features that make it particularly suitable for this investigation. This model is based on the creep hardening surface and is particularly useful for variable and fully reversed load histories. In Section 3, an implicit finite element algorithm for this model is derived. Details regarding implementation of this method into FVP and existing FE programs to study creep crack growth are also discussed. The results of the algorithm are verified against closed form solutions for simple geometries in Section 4. Sources of error and differences between using explicit and implicit schemes are also presented. Section 5 compares the numerical results with experimental data for the case of combined tension and torsion and fully reversed load histories. Section 6 provides results of some of the constant load creep crack growth analyses that have been performed to date. Because a wealth of experimental data has been developed for creep crack under constant load conditions, the need to develop our own creep growth data for this study was minimal. Conclusions of the Phase 1 work as well as work planned for the future are discussed in Section 7. Finally, Sections 8 and 9 discuss publications and the Phase 2 effort, respectively. Finally, the implementation of large strain and friction/contact algorithms into the finite element code and the implementation of three additional nonlinear constitutive laws (endochronic law, Bodner, and the Walker Model) are not discussed here. The large strain algorithm is complete, the endochronic theory is nearly complete, while subroutines for the Bodner and Walker models were obtained from the agencies described above. DOE

N92-18673# International Centre for Theoretical Physics, Trieste (Italy).

PATTERN FORMATION IN CONCENTRICALLY LOADED SQUARE PLATES

B. Tanatar and E. Canessa Apr. 1991 10 p

(DE92-603751; IC-91/77) Avail: NTIS HC/MF A02

The first steps towards modeling asymmetric multibranched crosslike crack growth in a 2D lattice have been taken. Preliminary results obtained from simplest deterministic and stochastic approaches of fracture propagation in defect-free media and comments on their associated fractal properties are presented. DOE

N92-18877*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.

THERMAL/STRUCTURAL ANALYSIS OF A TRANSPIRATION COOLED NOZZLE

Peyton B. Gregory, Jon E. Thompson, Dale A. Babcock, Carl E. Gray, Jr., and Chris A. Mouring Feb. 1992 33 p

(NASA-TM-104184; NAS 1.15:104184) Avail: NTIS HC/MF A03 CSCL 20K

The 8-foot High Temperature Tunnel (HTT) at LaRC is a combustion driven, high enthalpy blow down wind tunnel. In Mar.

1991, during check out of the transpiration cooled nozzle, pieces of platelets were found in the tunnel test section. It was determined that incorrect tolerancing between the platelets and the housing was the primary cause of the platelet failure. An analysis was performed to determine the tolerance layout between the platelets and the housing to meet the structural and performance criteria under a range of thermal, pressure, and bolt preload conditions. Three recommendations resulted as a product of this analysis.
Author

N92-18931# Wright Lab., Wright-Patterson AFB, OH.
FATIGUE DAMAGE SENSING USING ACOUSTIC EMISSION
Joseph R. Pokorski and Burton R. Fisher Sep. 1991 24 p
(AD-A243803; WL-TM-91-322-FIBT) Avail: NTIS HC/MF A03
CSCL 20/11

In structural fatigue testing, Acoustic Emission can be used to sense the beginning of fatigue damage (crack initiation) and then to monitor growth. If the initiation of damage can be detected early and then located on the structure, then downtime may be avoided or at least reduced to a minimum as the defect can be continuously monitored or repaired. Other methods for locating structural damage usually involve periodic shutdown of the test while visual inspections and other Non-Destructive Inspection (NDI) techniques are carried out. In addition to lost valuable time, this often involves a partial teardown of the structure. AE monitoring, on the other hand, involves passive monitoring of the test article while it is being cycled in load during fatigue testing. The Instrumentation Group of the Structures Test Branch (WL/FIBT) used the automated fatigue damage sensing system, using acoustic emission (AE) to locate the sources of possible structural failure during the fatigue test on the F-15 aircraft in the Structures Test Facility.
GRA

N92-18937# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
AN INVESTIGATION OF OPTIMALLY ROBUST STRUCTURAL DAMPING THROUGH FRACTIONAL ORDER FEEDBACK M.S. Thesis
Mark T. Leonard Dec. 1991 70 p
(AD-A243872; AFIT/GA/ENY/91D-2) Avail: NTIS HC/MF A04
CSCL 20/4

The purpose of this investigation was to determine if introducing fractional order states in a feedback system was beneficial to overall system performance. Fractional order differential equations have been used in the past primarily to model viscoelastic damping in structures. This study examined the use of fractional order differential equations in formulating a control algorithm with additional degrees of freedom. The algorithm presented is best suited for active structural damping. Including the fractional order time derivatives in the state allowed some additional flexibility in choosing relevant control parameters in the system. Optimization with respect to robustness was examined to determine a solution. Many additional questions arose in this inquiry as to the applications fractional order states in control systems.
GRA

N92-18949*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
FASTRAN-2: A FATIGUE CRACK GROWTH STRUCTURAL ANALYSIS PROGRAM
J. C. Newman, Jr. Feb. 1992 104 p
(NASA-TM-104159; NAS 1.15:104159) Avail: NTIS HC/MF A06
CSCL 20K

FASTRAN-2 is a life prediction code based on the crack closure concept and is used to predict crack length against cycles from a specified initial crack size to failure for many common crack configurations found in structural components. The life prediction method used in FASTRAN-2 is built around and analytical crack closure model. The model is based on plasticity induced fatigue crack closure and is used to calculate the stress level at which the crack tip becomes fully open during cyclic loading. The applied cyclic loads may be constant amplitude, variable amplitude or spectrum loading. Several standardized flight load spectra and other load spectra are included as options. Spectrum loads may also be input by the user as either a list of stress points or a flight by flight sequence. The program uses the crack closure concept to account for load interaction effects. Tensile or compressive loads can be applied. The program contains 17 predefined crack configurations; and the user can define one crack configuration. The crack opening stresses, as a function of load history and crack length, are calculated from the model and the effective stress intensity factor range, used to correlate fatigue crack growth rates, may be either or modified for plastic yielding at the crack tip. Ten example problems are included with the user guide to demonstrate the many options in FASTRAN-2. A computer program DKEFF was also developed to analyze lab specimen data to obtain the effective stress intensity factor against crack growth rate relations used by FASTRAN-2. A user guide for this program is also included and discussed.
Author

N92-18958*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
MINI-MAST CSI TESTBED USER'S GUIDE
Sharon E. Tanner, Richard S. Pappa, Jeffrey L. Sulla, Kenny B. Elliott, Robert Miserentino, James P. Bailey, Paul A. Cooper, Boyd L. Williams, Jr., and Anne M. Bruner (Lockheed Engineering and Sciences Co., Hampton, VA.) Jan. 1992 46 p
(NASA-TM-102630; NAS 1.15:102630) Avail: NTIS HC/MF A03
CSCL 20K

The Mini-Mast testbed is a 20 m generic truss highly representative of future deployable trusses for space applications. It is fully instrumented for system identification and active vibrations control experiments and is used as a ground testbed at NASA-Langley. The facility has actuators and feedback sensors linked via fiber optic cables to the Advanced Real Time Simulation (ARTS) system, where user defined control laws are incorporated into generic controls software. The object of the facility is to conduct comprehensive active vibration control experiments on a dynamically realistic large space structure. A primary goal is to understand the practical effects of simplifying theoretical assumptions. This User's Guide describes the hardware and its primary components, the dynamic characteristics of the test article, the control law implementation process, and the necessary safeguards employed to protect the test article. Suggestions for a strawman controls experiment are also included.
Author

N92-18971*# General Electric Co., Cincinnati, OH. Aircraft Engines.
THE 3D INELASTIC ANALYSIS METHODS FOR HOT SECTION COMPONENTS Final Report
R. L. McKnight, R. J. Maffeo, M. T. Tipton, and G. Weber Jan. 1992 179 p
(Contract NAS3-23698)
(NASA-CR-189089; NAS 1.26:189089) Avail: NTIS HC/MF A09
CSCL 20K

A two-year program to develop advanced 3D inelastic structural stress analysis methods and solution strategies for more accurate and cost effective analysis of combustors, turbine blades, and vanes is described. The approach was to develop a matrix of formulation elements and constitutive models. Three constitutive models were developed in conjunction with optimized iterating techniques, accelerators, and convergence criteria within a framework of dynamic time incrementing. Three formulation models were developed: an eight-noded midsurface shell element; a nine-noded midsurface shell element; and a twenty-noded isoparametric solid element. A separate computer program has been developed for each combination of constitutive model-formulation model. Each program provides a functional stand alone capability for performing cyclic nonlinear structural analysis. In addition, the analysis capabilities incorporated into each program can be abstracted in subroutine form for incorporation into other codes or to form new combinations.
Author

N92-19003*# Analytical Services and Materials, Inc., Hampton, VA.
GENSURF: A MESH GENERATOR FOR 3D FINITE ELEMENT ANALYSIS OF SURFACE AND CORNER CRACKS IN FINITE THICKNESS PLATES SUBJECTED TO MODE-1 LOADINGS
I. S. Raju Feb. 1992 58 p
(Contracts NAS1-18599; NAS1-19317)
(NASA-CR-189559; NAS 1.26:189559) Avail: NTIS HC/MF A04 CSCL 20K

A computer program that generates three-dimensional (3D) finite element models for cracked 3D solids was written. This computer program, gensurf, uses minimal input data to generate 3D finite element models for isotropic solids with elliptic or part-elliptic cracks. These models can be used with a 3D finite element program called surf3d. This report documents this mesh generator. In this manual the capabilities, limitations, and organization of gensurf are described. The procedures used to develop 3D finite element models and the input for and the output of gensurf are explained. Several examples are included to illustrate the use of this program. Several input data files are included with this manual so that the users can edit these files to conform to their crack configuration and use them with gensurf. Author

N92-18573# Centre d'Essais Aeronautique Toulouse (France). Div. Materiaux et Structures.
FATIGUE SAFETY FACTOR: ASSESSMENT OF ASSOCIATED SAFETY LEVEL
V. Dehaye *In* AGARD, Fatigue Management Dec. 1991 5 p In FRENCH (For primary document see N92-18571 09-05)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

42 GEOSCIENCES (GENERAL)

No abstracts in this category.

43 EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography.

For instrumentation see *35 Instrumentation and Photography.*

N92-18048*# Ohio State Univ., Columbus. Dept. of Civil Engineering.
COMMERCIAL POTENTIAL OF REMOTE SENSING DATA FROM THE EARTH OBSERVING SYSTEM Final Report
Carolyn J. Merry and Sandra M. Tomlin Feb. 1992 46 p
(Grant NAGw-973; RF Proj. 765707/724377)
(NASA-CR-189886; NAS 1.26:189886) Avail: NTIS HC/MF A03 CSCL 05B

The purpose was to assess the market potential of remote sensing value-added products from the Earth Observing System (EOS) platform. Sensors on the EOS platform were evaluated to determine which qualities and capabilities could be useful to the commercial user. The approach was to investigate past and future satellite data distribution programs. A questionnaire was developed for use in a telephone survey. Based on the results of the survey of companies that add value to remotely sensed data, conversations with the principal investigators in charge of each EOS sensor, a study of past commercial satellite data ventures, and reading from the commercial remote sensing industry literature, three recommendations were developed: develop a strategic plan for commercialization of EOS data, define a procedure for commercial users within the EOS data stream, and develop an Earth Observations Commercial Applications Program-like demonstration program within NASA using EOS simulated data. Author

N92-18349# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
REPORTS ON CARTOGRAPHY AND GEODESY, SERIES 1, NUMBER 105 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN]
1990 205 p In ENGLISH and GERMAN
(ISSN-0469-4236; ETN-92-90830) Avail: NTIS HC/MF A10

A cartographic data base in SQL was realized. Pattern recognition was used for queued editing of scanning digitations. The ATKIS data model was introduced. Triangulation methods were adapted. Digital terrain models were integrated in Geographic Information System (GIS). An integrated data base for ALK/ATKIS applications is presented. A topographic map series was revised using vector and raster data processing. The conceptual phase of the ATKIS project was completed. Automation in cartography is treated. Network related transactions in GSI are presented. The ALK/ATKIS data structures were integrated in the GIS SICAD. Digital orthoprojection was used for the extraction of landscape oriented data. ATKIS data structures were represented using a photogrammetric-cartographic system. The GIS support of data management and processing is presented. Applications of the GIS IRIS are given. For individual titles, see N92-18350 through N92-18368.

N92-18350# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
DESIGN AND REALIZATION OF CARTOGRAPHIC DATABASE IN SQL [ENTWURF UND REALISIERUNG EINER KARTOGRAPHISCHEN DATENBANK IN SQL]
Ralf Ackermann *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 7-17 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The structure of a data base for cartographic information, based on the classical relational model is described. The design of the relational data base as well as the performance ratings with the realized data base are emphasized with a view to the evaluation of the concepts. For the purpose of performance ratings an inquiry was defined, the result of which was determined through various algorithms. The realized cartographic data base, based on the classical relational model leads to unacceptable response times for the measurement of performance ratings. Improvements were obtained by the introduction of redundancy in the data base, but the final solution requires the use of parallel processing concepts and parallel computer systems to process the geographic data inventories. ESA

N92-18351# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
PATTERN RECOGNITION FOR QUEUED EDITING OF SCANNING DIGITATIONS [MUSTERERKENNUNG ZUR AUTOMATISCHEN BILDSCHIRMFUEHRUNG BEIM EDITING VON SCAN-DIGITALISIERUNGEN]
Juergen Brennecke *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 19-29 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

Queued editing is introduced, using as an example the case of cartographic pattern recognition. Queued editing means that the operator receives directly at the screen the map details he has to treat interactively, instead of having to search for them in a difficult way. The basis of such queued editing is often cartographic pattern recognition. Queued editing can be kept relatively simple and is hence of economic interest as an ergonomic mixture of computer diligence and human decision making capability. The procedure is described by means of several examples from the domain of automatic data acquisition from map originals. ESA

N92-18352# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
THE ATKIS DATA MODEL [DAS ATKIS-DATENMODELL]
Heinz Brueggemann *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 31-40 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The ATKIS data model is presented. This model is the basis for the definition of the topographical-cartographical reality from the data systems point of view, as well as for the system independent realization of the ATKIS standard and for the data exchange. The model contains special instructions as to its implementation in the ALK (Automated Property Map) components ALK data base, ALK GIAP and EDBS. Its object oriented descriptional approach meets the emerging possibilities of future modern information systems. In future object-oriented data bases it may be transferred directly into an extended central data dictionary and thus provide the knowledge about the correct structuring of the data to the user as well as to the processing procedures. If further possibilities of object oriented approaches are consistently used, the ATKIS standardization effect reached so far can still be considerably improved. ESA

N92-18353# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
NEW STUDIES OF TRIANGULATION [NEUERE UNTERSUCHUNGEN ZUR DREIECKSVERMASCHUNG]
Gerd Buziek *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 41-53 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

Recent studies in the field of triangulation methods are treated. Rigid triangulation methods are often used for the computation of digital terrain models. However, these algorithms cannot allow for linear terrain information during the triangulation process. Therefore, a procedure was developed that ensures triangulation without manipulating the set of control points, thus forming within the triangulation net the structural information necessary for the geomorphologically correct representation of the terrain. ESA

N92-18354# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
USER-ORIENTED DATA STRUCTURES FOR THE DIGITAL 1:4000 BASIC MAP OF WEST BERLIN IN THE REALIZATION OF A SECONDARY USER [ANWENDERORIENTIERTE DATENSTRUKTUREN FUER DIE DIGITALE GRUNDKARTE 1:4000 VON BERLIN (W) IN DER REALISATION EINES SEKUNDAERANWENDERS]
Werner Dransch *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 55-70 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The data structures of the digital basic map of West Berlin were adapted, with a view to the use by the Senate Administration for Urban Development and Environmental Protection. Analog data assets are frequently not digitally acquired by the user himself. Economic and political reasons require a central data acquisition before transmission to secondary users. A prerequisite for this procedure is the possibility to exchange data, without problems between data capture and secondary data user. A concept for a user oriented data base is presented. ESA

N92-18355# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
INTEGRATION OF DIGITAL TERRAIN MODELS IN GEOGRAPHIC INFORMATION SYSTEMS: CONCEPT AND REALIZATION [INTEGRATION VON DIGITALEN GELAENDEMODELLEN IN GEOINFORMATIONSSYSTEME: KONZEPT UND REALISIERUNG]
Heinrich Ebner, Rainer Hoessler, and Roland Wuerlaender *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 71-76 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The concept and the realization of an efficient integration of height information into Geographic Information Systems (GIS) are presented. The combined processing of planimetric and height information is becoming more and more important in GIS. For many GIS, which were designed in two dimensions only, the integration of height information is of high benefit. The various possibilties of this integration are discussed. An efficient and elegant integration into GIS was developed for the DTM (Digital Terrain Model) program package HIFI-88. This does not require modifications to the existing GIS and the data bases. ESA

N92-18356# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
INTEGRATED DATA BASES (IDB) FOR ALK/ATKIS APPLICATIONS [INTEGRIERTE DATENBANK (IDB) FUER ALK/ATKIS-ANWENDUNGEN]
Dirk Findeisen and Thomas Englert *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 77-86 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

An Integrated Data Base (IDB) which is actually implemented for ALK-GIAP users, is presented. All planimetric and non-graphical data are administrated in an ALK/ATKIS conformal structure on the basis of a relational data base system. IDB has application fields in industry, in local authorities and in land administrations. It serves as long term storage for geographical data which can be acquired, transformed, evaluated, and output with the ALK-GIAP system. The planimetric data can be stored in vector form as well as in raster form. ESA

N92-18357# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
REVISION OF THE TOPOGRAPHIC MAP SERIES 1:25,000 USING CARTOGRAPHIC VECTOR DATA AND RASTER DATA PROCESSING: CONCEPTION AND RESULTS [FORTFUERHRUNG DER TK 25 DURCH KARTOGRAPHISCHE VEKTOR- UND RASTERDATENVERARBEITUNG: KONZEPTION UND ERSTE TESTERGEBNISSE]
Dietmar Gruenreich *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 87-99 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The revision of the topographic map series 1:25,000 using cartographic vector data and raster data processing, is presented. The aim is not only to apply digital technology in topographic map production of traditional quality for a transition period until ATKIS (a governmental digital topographic-cartographic information system in the FRG) is well estblished, but also to train the personnel and to provide facilities for map production and revision in ATKIS environment. ESA

N92-18358# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
COMPLETION OF THE CONCEPTUAL PHASE OF THE AdV PROJECT [DAS ADV-VORHABEN ATKIS: ZUM ABSCHLUSS DER KONZEPTIONSPHASE]
Rolf Harbeck *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 101-107 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The results of the conceptual phase of the AdV project ATKIS (Governmental topographic cartographic information system), and the beginning of the realization and data production phase are described. The initial requirements of the AdV were the reorganization of the topographic mapping services with special emphasis on the connections between the topographic data bases, and the transformation in digital form. The conceptual phase went substantially beyond these requirements. The main result is that in digital terrain models data on relief, topography and Earth surface can be alpha numerically encoded and stored in a data base,

independently of the cartography representation. The planning for the production phase and for the development of the data base software is outlined. ESA

N92-18359# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
AUTOMATION IN CARTOGRAPHY [AUTOMATION IN DER KARTOGRAPHIE]
Detlev Kosmann, Gunter Schreier, and Hans-Joachim Lotz-Iwen *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 109-114 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The function of the German processing and Achieving Facility (D-PAF) is described. The D-PAF is responsible for the processing of the Earth Resources Satellite-1 (ERS-1) Synthetic Aperture Radar (SAR) data. The geocoding system is a part of the D-PAF. It is planned to implement three data bases in the system: a map library system, a digital elevation model, and a ground control point database. These three data bases and their function in the geocoding system are described. ESA

N92-18360# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
NETWORK-RELATED TRANSACTIONS IN GEO-INFORMATION SYSTEMS [NETZBEZOGENE TRANSAKTIONEN IN GEO-INFORMATIONSSYSTEMEN]
Horst Kremers *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 115-124 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

Aspects of cartographic communication systems, in network oriented applications, are considered. The emphasis, of these systems, is on distributed applications and decentralized functionality. The relevant elements of the systems architecture (software, hardware, and network) are indicated. Corresponding methods and techniques of computer science and systems engineering are related to the field of digital cartography and geographic-information systems. Central to the subject are questions concerning the details of modularizing of processes, the facilties of parallelizing subtasks, and the needs of synchronization in an environment of heterogenous processors. ESA

N92-18361# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
INTEGRATION OF THE ALK/ATKIS DATA STRUCTURES IN THE GEO-INFORMATION SYSTEM SICAD [INTEGRATION DER ALK/ATKIS-DATENSTRUKTUREN IN DAS GEO-INFORMATIONSSYSTEM SICAD]
Franz Kudorfer *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 125-129 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

Further development of the geographic information system, Siemens Computer Aided Design (SICAD), was performed with a view to the use of SICAD as a processing unit in the sense of the Automated Cadastral Map (ALK) and of the Governmental Digital Topographic-Cartographic Information System (ATKIS). The components developed for SICAD render possible administration of objects conformal to the ALK and ATKIS, as well as their input and output via EDBS. SICAD can also be employed as an overall system for data maintenance and data cession to secondary users. ESA

N92-18362# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
DIGITAL ORTHOPROJECTION FOR THE EXTRACTION OF DLM DATA FOR ATKIS [DIGITALE ORTHOPROJEKTION ZUR GEWINNUNG VON DLM-DATEN FUER ATKIS]
Werner Mayr and Rolf Thiemann *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 131-138 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The use of digitally generated color orthophotos for the purpose of extraction of Digital Landscape Model (DLM) data for a governmental topographic and cartographic information system (ATKIS) is outlined. The method of digital orthoprojection is discussed. A program system able to produce digital color orthophotos and its performances are presented. This program system is part of the IABG data processing service catalog. Possibilities to extract DLM data from digital orthophotos are described. The digital orthophotos offer information on the basis of a map coordinate system. It is available to ATKIS for the visualization of topographic and carthographic bulk data and offers the extraction of DLM data on the basis of raster data. ESA

N92-18363# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
REPRESENTATION OF ATKIS DATA STRUCTURES WITH PHOCUS [ABBILDUNG VON ATKIS-DATENSTRUKTUREN MIT PHOCUS]
Kurt Menke *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 139-146 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The representation of the Governmental Topographic and Cartographic Information Systems (ATKIS) data structures using the photogrammetric cartographic system (PHOCUS) of the firm Carl Zeiss is outlined. PHOCUS is used for the data acquisition and maintenance of the ATKIS-Digital Landscape Model (DLM). For that purpose a data converter is being developed which enables transfer of data between PHOCUS and the ATKIS data base via the data base EDBS. Some conceptual and technical aspects of the project are presented. ESA

N92-18364# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
GIS DATA MANAGEMENT TO SOLVE THE PROBLEMS OF THE MULTIPURPOSE CADASTRE: THE INFOCAM SOLUTION FOR THE SWISS RAV PROJECT [GIS-DATENVERWALTUNG ZUR LOESUNG VON AUFGABEN DES MEHRZWECKKATASTERS: DIE INFOCAM-LOESUNG ZUR RAV DER SCHWEIZ]
Matthias Uhlenbruck *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 147-153 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The GIS (Geographic Information System) support of data management and data processing with a view to solving cadastral problems is presented, taking example for the INFOCAM solution for the Swiss RAV (reformation of governmental geodetic measurements). Many countries undertake a reform of the existing forms of land record keepings to close the gap between available and demanded information. Especially, cadastral services are changing to a multipurpose cadastre offering manifold information. Automatic data processing is an important tool in solving the problems. GIS can support the data management and processing considerably. INFOCAM with its module INCA (INfocam Cadastral Application) allows the fully numerical, graphically interactive follow up of cadastral data. ESA

N92-18365# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
APPLICATIONS OF THE INTEGRATED GEOCODED INFORMATION SYSTEM IRIS [ANWENDUNGSBEISPIELE DES INTEGRIERTEN RAUMBEZOGENEN INFORMATIONSSYSTEMS IRIS]
Manfred Weisensee *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 155-165 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

Examples of applications and experience with the newly developed integrated geocoded information system IRIS are

presented. IRIS is a program package for applications in cartography, environment planning, and regional planning. The present pilot project had the intention to make quantitative landscape analyses. The object of the investigation were mapped biotopes. The results of the evaluation on the form of maps, diagrams, and tables help the expert to document the inventory, give him a basis for planning, and serve as a decision making aid in the evaluation of planning alternatives. ESA

N92-18366# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
QUADTREE DATA STRUCTURES AS A BASIS FOR GEO-INFORMATION SYSTEMS WITH VECTOR AND RASTOR DATA: BASIC DATA GEOMETRY AND TOPOLOGY OF INTEGRATED THEMATIC DATABASES [QUADTREE-DATENSTRUKTUREN ALS BASIS FUER GEO-INFORMATIONSSYSTEME MIT VEKTOR- UND RASTERDATEN: BASISDATEN, GEOMETRIE UND TOPOLOGIE VON INTEGRIERTEN THEMATISCHEN DATENBANKEN]
Hongguang Yang *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 167-196 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The quadtree data structure was used as a basis for a geographic information system with vector and raster data. The concept of a 'thematic data base' with vector and raster data is introduced as an integrated part of a geographic information system. The concept of 'Euler structure' is defined and characterized as the formal description of thematic data bases with the rigid topology. The quadtree structure and its application possibilities are outlined; the two important operations, i.e., intersection of surfaces and transformation between the vector and raster data, are discussed. The quadtree approaches for the intersection of surfaces and for raster-vector conversion provide a complete answer to the known problems of all present approaches. ESA

N92-18367# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
AUTOMATIC ACQUISITION OF CONTOUR LINE MAPS USING THE PATTERN RECOGNITION METHOD [AUTOMATISCHE ERFASSUNG DER HOEHENLINIENFOLIEN MIT VERFAHREN DER MUSTERERKENNUNG]
Jun Yang *In its* Reports on Cartography and Geodesy, Series 1, Number 105 1990 p 197-206 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The automatic acquisition of contour line maps based on pattern recognition methods is described. The map is digitized by means of a scanner and the raster data are then converted into vector data in line-node format, and input in a data base with topological and spatial relations. The segmentation is carried out to separate data depending on the object type: contour lines, numbers, and symbols. Dotted contour lines are recognized by combined syntactical and numerical classification, followed by recognition of points and figures describing the height information. The height information is then assigned to the contour lines as an attribute with the help of the knowledge base on grounds of morphological characteristics of the terrain. ESA

N92-18368# Institut fuer Angewandte Geodaesie, Frankfurt am Main (Germany, F.R.).
MANIPULATION OF GEOMETRIC OBJECTS IN PROLOG [MANIPULATION GEOMETRISCHER OBJEKTE IN PROLOG]
Martin Zeller *In its* Reports in Cartography and Geodesy, Series 1, Number 105 1990 p 207-211 In GERMAN; ENGLISH summary (For primary document see N92-18349 09-43)
Avail: NTIS HC/MF A10

The use of PROLOG in a geographic information systems is discussed. The capability of expression of PROLOG is higher than that of an interrogative data base language, e.g., SQL. At the same time, PROLOG is more flexible and problem oriented than for example FORTRAN. However, and essential prerequisite for the useful employment of PROLOG on a geographic information system is a clearly defined interface to the machine oriented components of the system. The tasks of an abstract, symbolic level definition of logic, verification of consistency rules, content oriented inquiries can then be implemented elegantly in an easily visible manner. ESA

N92-18431# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
WATER STORAGE IN THE SOIL OF A TERRA FIRME FOREST AND A RUBBER TREE PLANTATION Thesis
Osvaldo Machado Rodr Cabral Jun. 1991 119 p In PORTUGUESE; ENGLISH summary
(INPE-5282-TDI/452) Avail: NTIS HC/MF A06

Routine measurements of soil water content (neutron probe) and matric potentials (tensiometers), were made in soil with a rubber tree plantation and a 'Terra Firme' forest, during 1985 and 1986, in Manaus. The soil moisture content in the rubber tree plantation was greater than 70 pct. of the storage capacity, and during 10 months (Nov. to Aug.), the drainage process was detected. The largest water storage variation, associated with the dry season of 1985, was -27.4 + or - 6.6 mm, over the 0 to 170 cm layer, showing the main radicular activity in the depths ranging from 50 to 120 cm, as a consequence of surface compaction. In the forest, even during the wet season (Jan. to Apr.), significant amounts of water were absorbed by the vegetation at the surface layer, related with short dry spells, which stop temporarily the drainage process. The highest quantity of water extracted by the root system was -57.0 + or - 7.0 mm, down to 170 cm depth, and the soil moisture was maintained above 60 pct. of the soil storage capacity. The average daily evapotranspiration in the forest, estimated in 1985 was 3.4 + or - 0.4 mm/day; in the rubber tree plantation, the estimative was 2.5 + or - 0.6 mm/day. Author

N92-18441*# Texas A&M Univ., College Station. Engineering Experiment Station.
BASIC STUDIES IN MICROWAVE REMOTE SENSING Final Technical Report
Adrian K. Fung and Jonathan Bredow 23 Jan. 1992 15 p
(Grant NAGw-1800)
(NASA-CR-189912; NAS 1.26:189912) Avail: NTIS HC/MF A03 CSCL 08B

Scattering models were developed in support of microwave remote sensing of earth terrains with particular emphasis on model applications to airborne Synthetic Aperture Radar measurements of forest. Practically useful surface scattering models based on a solution of a pair of integral equations including multiple scattering effects were developed. Comparisons of these models with controlled scattering measurements from statistically known random surfaces indicate that they are valid over a wide range of frequencies. Scattering models treating a forest environment as a two and three layered media were also developed. Extensive testing and comparisons were carried out with the two layered model. Further studies with the three layered model are being carried out. A volume scattering model valid for dense media such as a snow layer was also developed that shows the appropriate trend dependence with the volume fraction of scatterers. Author

N92-18459# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
UTILIZATION OF VARZEA: THE ECOLOGICALLY SUSTAINABLE EXPLORATION ALTERNATIVE FOR THE AMAZONIA
Sherry Chou Chen Jun. 1991 10 p
(INPE-5250-NTC/297) Avail: NTIS HC/MF A02

The most desirable systems for development of the Amazonia are those best able to take advantage of the natural occurring resources of the rain forest. Development projects have to be ecologically feasible. Projects based on these criteria, in the long term, are more profitable, more socially and politically beneficial, and above all less environmentally disturbing. There are two landscapes in the Amazonia: nonfloodable firm land that has the poorest soils on earth, and seasonal floodplains, or varzeas, which

include valleys of the Amazonian whitewater rivers which are inundated annually. Both of these landscapes are discussed. The utilization potential of the varzeas with respect to fishery, irrigated rice, and water buffalo is also discussed. Mapping of the varzeas using remote sensing data is addressed. Author

N92-18945# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
STUDY OF THE ATMOSPHERIC BOUNDARY LAYER USING LANDSAT SATELLITE IMAGERY M.S. Thesis
Lucia Helena Ribas Machado Dec. 1991 141 p In PORTUGUESE; ENGLISH summary
(INPE-5351-TDI/460) Avail: NTIS HC/MF A07

Analyses of smoke plumes that are originated over coastal regions using LANDSAT imagery together with radiosonde data, or radiosonde data alone, permits the evaluation of air pollution events and the examination of some theoretical principles of transport phenomena. The lateral eddy mass diffusivity coefficient (K sub y), for the plume supposed Gaussian, was evaluated from the standard deviation of the plume spread (s sub y), obtained from LANDSAT imagery. The vertical eddy mass diffusivity (K sub z) was determined through Weinstock's model, which uses the kinetic energy dissipation rate (sigma), obtained from both LANDSAT imagery and radiosonde data, together with the Brunt-Vaissala frequency (N), which is calculated from radiosonde data. Also, the flux Richardson number (R sub f), the Ozmidov scale (L sub o) and the gradient Richardson number (R sub i), the last one indicating the atmospheric stability, were obtained. All of the atmospheric boundary layer parameters show the same dependence on stability, which is equal to the one observed either in the ocean or in the lab, where for Ri = Ri sub c the mixture rate passes through has a maximum; for Ri less than Ri sub c, the turbulence is active, while for Ri greater than Ri sub c, the buoyance suppresses progressively the turbulence. The value of K sub y and K sub z range, respectively, from 10(exp 1) to 10(exp 2) and 10(exp -3) to 10(exp 1) sq m/s for a stable stratification, while between sigma and N an expression of the form sigma = aN sup y is obtained, with y lying between 0.5 and 1.0. These results agree well with previous experimental values obtained over water surfaces by others. Author

N92-18946# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Div. de Sensoriamento Remoto e Meteorologia Espacial.
INTERNATIONAL TRAINING COURSE ON REMOTE SENSING-BRAZIL: FIVE YEARS TRAINING SPECIALISTS IN REMOTE SENSING APPLIED TO NATURAL RESOURCES
Tania Maria Sausen Sep. 1991 12 p Presented at the 24th International Symposium on Remote Sensing of the Environment, Rio de Janeiro, Brazil, 27-31 May 1991
(INPE-5316-PRE/1713) Avail: NTIS HC/MF A03

The objective of the International Course on Remote Sensing is to qualify specialists from developing countries in remote sensing research and techniques for survey and monitoring of natural resources. Since 1985 INPE has held four international courses in this area in cooperation with the UN Outer Space Affairs Div., the United Nations Univ., the European Space Agency, and the Coordination for the Improvement of Higher Education Personnel. For the last five years, INPE has been training 38 specialists in remote sensing from Latin American and African countries. General information is provided about the course and an evaluation is made about the courses for the last five years. Author

44 ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower.

For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *28 Propellants and Fuels.*

N92-18209# Oak Ridge National Lab., TN.
PROJECT SUMMARY: PHYSICAL CHEMISTRY OF GEOTHERMAL SYSTEMS
R. E. Mesmer, D. R. Cole, H. F. Holmes, D. A. Palmer, J. M. Simonson, and D. J. Wesolowski 1991 25 p Presented at the Geothermal Energy Peer Review, Salt Lake City, UT, 4 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004342; CONF-911270-1) Avail: NTIS HC/MF A03

We have completed solubility studies on gibbsite to 100 C in several electrolyte media and derived speciation of Al(exp 3+) in solution; defined the ionization constant for HSO4 at 250 C in brine compositions to 5 molal and completed measurements of the ion-interaction parameters for NaHSO44 (aq) to 250 C; measured volatility of HCl over aqueous HCl to 350 C and applied derived model to the conditions of the Geysers; and completed measurements of the effects of NaCl and KCl on D/H and O-18/O-16 liquid-vapor partitioning are complete to 100 C and to 6 molal. Studies on the effects of MgCl2 and CaCl2 and their mixtures are underway. DOE

N92-18223# Los Alamos National Lab., NM.
ORIENTATION OF MINIMUM PRINCIPAL STRESS IN THE HOT DRY ROCK GEOTHERMAL RESERVOIR AT FENTON HILL, NEW MEXICO
K. L. Burns 1991 5 p Presented at the Geothermal Resources Council Annual Meeting and Trade Show, Reno, NV, 6-9 Oct. 1991
(Contract W-7405-eng-36)
(DE91-014743; LA-UR-91-1990; CONF-9110151-3) Avail: NTIS HC/MF A01

The stress field at the source of microearthquakes in the interior of the hot dry rock (HDR) geothermal reservoir at Fenton Hill appears to be different from the far field stress outside the reservoir. The stress field seems to be re-oriented prior to failure, during the course of processes that inflate the reservoir. The state of stress, both inside and outside, the HDR geothermal reservoir at Fenton Hill, is important in predicting the course of stress-dependent processes, and in transferring HDR technology developed at Fenton Hill, to sites, such as at Clearlake in California, where the stress field is expected to be substantially different. The state of stress at Fenton Hill is not well known because of limitations in stress measuring technology. It is necessary to use a variety of indirect methods and seek an estimate of the stress. DOE

N92-18224# Midwest Research Inst., Golden, CO.
SERI PHOTOVOLTAIC SUBCONTRACT REPORTS: ABSTRACTS AND DOCUMENT CONTROL INFORMATION, 1 JANUARY - 3 JULY 1991
Oct. 1991 15 p
(Contract DE-AC02-83CH-10093)
(DE91-015005; NREL/TP-214-4459) Avail: NTIS HC/MF A03

This report contains the document control information and abstracts for SERI Photovoltaic (PV) Program publications resulting from SERI's subcontracted PV research. The information is presented for reports published or distributed from 1 Jan. - 31 Jul. 1991. This report will outline these publications, organized by technology, on a regular basis. A list of additional publications and sources is included herein to provide the photovoltaic community with other sources of information. DOE

N92-18225# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY, PHASE 1
S. Brown, D. S. Shen, and N. Heeke (Glasstech Solar, Inc., Golden, CO.) Nov. 1991 61 p
(Contract DE-AC02-83CH-10093)
(DE91-015025; NREL/TP-214-4489-Phase-1) Avail: NTIS HC/MF A04

This report describes design concepts for improved thin-film module production, including three process steps: (1) the front-end step, which includes washing, transparent conductive oxide (TCO) deposition, and patterning; (2) the P-I-N-M step where the photovoltaic cell structure is deposited, including the back contact, without breaking vacuum; and (3) the back end step, which includes masking, etching, washing, subcell testing and repair, interconnection, and encapsulation. The design is flexible and can be configured to a variety of applications. The front and back sections (steps 1 and 3) include a number of rotate modules and spacer conveyors. These modules and conveyors enable the line to hold and release glass panels according to the requirements of the process stations. DOE

N92-18260# Midwest Research Inst., Golden, CO.
CONSERVATION AND RENEWABLE ENERGY TECHNOLOGIES FOR INDUSTRY
Oct. 1991 20 p
(Contract DE-AC02-83CH-10093)
(DE91-002107; DOE/CH-10093/87) Avail: NTIS HC/MF A03

This publication presents current efforts by the US DOE Office of Industrial Technologies to increase national end-use efficiency and promote renewable energy use in industrial applications. This also entails reducing industrial and municipal waste and the associated environmental impacts and hazards. The transfer of research results to commercial practice in such industries as petroleum refining, chemicals, primary metals, pulp and paper, food, and textiles is a vital step in energy conservation. DOE

N92-18536# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
THE FEASIBILITY OF APPLYING GEOPRESSURED-GEOTHERMAL RESOURCES TO DIRECT USES
Ben C. Lunis, Jane Negus deWys, Martin M. Plum, Paul J. Lienau (Oregon Inst. of Tech., Klamath Falls.), F. J. Spencer, and George F. Nitschke Sep. 1991 130 p
(Contract DE-AC07-76ID-01570)
(DE92-003361; EGG-EP-9839) Avail: NTIS HC/MF A07

This study concludes that direct use technologies, especially desalinated water production, can contribute significantly to the value added process and the overall economic viability in developing a geopressured resource. Although agriculture and aquaculture applications are marginal projects when they are the only use of a geopressured well, the small margin of profitability can contribute to improving the overall economics of the direct use development. The added complexity from a technical and management aspect may add to the overall risk and unpredictability of the project. Six combinations of direct uses received economic evaluation that resulted in 15 percent discounted payback periods ranging from 4 to over 10 years. Many other combinations are possible depending on the resource and market variables. Selection of appropriate technologies and sizes of applications will be established by the developer that engages in geopressured resource utilization. Currently, many areas of the country where geopressured resources are located also have surplus electrical capacity and generation; thus power utilities have been selling power for less than two cents per kWH, well below a reasonable breakeven value for geopressured produced electricity. However, when the energy demand of the integrated geopressured facility is large enough to install power generation equipment, operating expenses can be reduced by not paying the 10 to 12 cents per kWH utility rate. The study includes an analysis of a geothermal turbine unit installed with a desalination and an agriculture/aquaculture facility, taking advantage of the cascading energy values. Results suggest that this scenario becomes profitable only where the market price for electricity exceeds five cents per kWH. DOE

N92-18597# Sandia National Labs., Albuquerque, NM.
PHOTOVOLTAICS AS A WORLDWIDE ENERGY OPTION: A CASE STUDY IN DEVELOPMENT STRATEGY
G. Jones, R. Pate, and R. Hill 1991 14 p Presented at the 1991 Asia Energy Conference, Bangkok, Thailand, 17-20 Oct. 1991
(Contract DE-AC04-76DP-00789)
(DE92-004733; SAND-91-2408C; CONF-9110299-1) Avail: NTIS HC/MF A03

Renewable energy technologies, such as solar thermal electric, photovoltaics (PV), and wind energy have made significant gains in cost and performance in the past decades. As a result, there have been high expectations on the part of the public for these sources to play a major role in future energy supply, especially as environmental concerns about conventional sources increase. Despite these past gains and high expectations, the global potential of renewable energy technologies still remains largely untapped, principally because of issues of industrialization and user acceptance. There is increasing recognition that government energy programs must incorporate a broader strategy than the traditional basic research role if they are to address these issues. Essential elements of this strategy are affordable technology, a healthy industry, sustained market growth, user acceptance, and equitable policy and financial environments. The U.S. Department of Energy (DOE) programs in solar electric conversion have already started the development of the required broader based effort. This paper presents the status of that work, using the U.S. National Photovoltaic Program as a case study. DOE

N92-18600# Sandia National Labs., Albuquerque, NM.
MODELLING AND FABRICATION OF HIGH-EFFICIENCY SILICON SOLAR CELLS
A. Rohatgi, A. W. Smith, and J. Salami (Georgia Inst. of Tech., Atlanta.) Oct. 1991 176 p
(Contract DE-AC04-76DP-00789)
(DE92-004781; SAND-91-7013) Avail: NTIS HC/MF A09

This report covers the research conducted on modelling and development of high efficiency silicon solar cells during the period May 1989 to August 1990. First, considerable effort was devoted toward developing a ray tracing program for the photovoltaic community to quantify and optimize surface texturing for solar cells. Second, attempts were made to develop a hydrodynamic model for device simulation. Such a model is somewhat slower than drift-diffusion type models like PC-1D, but it can account for more physical phenomena in the device, such as hot carrier effects, temperature gradients, thermal diffusion, and lattice heat flow. In addition, Fermi-Dirac statistics have been incorporated into the model to deal with heavy doping effects more accurately. The third and final component of the research includes development of silicon cell fabrication capabilities and fabrication of high efficiency silicon cells. DOE

N92-18601# Sandia National Labs., Albuquerque, NM.
CHARACTERISTICS, FINITE ELEMENT ANALYSIS, TEST DESCRIPTION, AND PRELIMINARY TEST RESULTS OF THE STM4-120 KINEMATIC STIRLING ENGINE
K. L. Linker, K. S. Rawlinson, and G. Smith Oct. 1991 50 p
(Contract DE-AC04-76DP-00789)
(DE92-004784; SAND-90-1162) Avail: NTIS HC/MF A03

The Department of Energy's Solar Thermal Program has, as one of its program elements, the development and evaluation of conversion device technologies applicable to dish-electric systems. The primary research and development combines a conversion device (heat engine), solar receiver, and generator mounted at the focus of a parabolic dish concentrator. The Stirling-cycle heat engine was identified as the conversion device for dish-electric with the most potential for meeting the program's goals for efficiency, reliability, and installed cost. To advance the technology toward commercialization, Sandia National Laboratories has

acquired a Stirling Thermal Motors, Inc. kinematic Stirling engine, STM4-120, for evaluation. The engine is being bench-tested at Sandia's Engine Test Facility and will be combined later with a solar receiver for on-sun evaluation. This report presents the engine characteristics, finite element analyses of critical engine components, test system layout, instrumentation, and preliminary performance results from the bench test. DOE

N92-18672# Sandia National Labs., Albuquerque, NM.
PROCESS DEVELOPMENT FOR HIGH-EFFICIENCY SILICON SOLAR CELLS
J. M. Gee, P. A. Basore, M. E. Buck, D. S. Ruby, W. K. Schubert, B. L. Silva, and J. W. Tingley 1991 8 p Presented at the 6th International Photovoltaic Science and Engineering Conference, New Delhi, India, 10-14 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004741; SAND-91-2515C; CONF-920227-2) Avail: NTIS HC/MF A02

Fabrication of high-efficiency silicon solar cells in an industrial environment requires a different optimization than in a laboratory environment. Strategies are presented for process development of high-efficiency silicon solar cells, with a goal of simplifying technology transfer into an industrial setting. The strategies emphasize the use of statistical experimental design for process optimization, and the use of baseline processes and cells for process monitoring and quality control. DOE

N92-18723# Sandia National Labs., Albuquerque, NM.
PHOTOVOLTAICS AS A WORLDWIDE ENERGY SOURCE
G. J. Jones 1991 8 p Presented at the 6th International Photovoltaic Science and Engineering Conference, New Delhi, India, 10-14 Feb. 1992
(Contract DE-AC04-76DP-00789)
(DE92-004735; SAND-91-2599C; CONF-920227-1) Avail: NTIS HC/MF A02

Photovoltaic energy systems have historically been treated as a bulk power generation source for the future. However, utilities and other agencies involved with electrification throughout the world are beginning to find photovoltaics a least-cost option to meet specific loads both for themselves and their customers, in both off-grid and grid-connected applications. These expanding markets offer the potential of hundreds of megawatts of sales in the coming decade, but a strategy addressing both industrial growth and user acceptance is necessary to capitalize on this opportunity. DOE

N92-18858# Midwest Research Inst., Golden, CO.
PHOTOVOLTAIC MANUFACTURING TECHNOLOGY
H. Somberg Nov. 1991 30 p
(Contract DE-AC02-83CH-10093)
(DE92-001152; NREL/TP-214-4480) Avail: NTIS HC/MF A03

This report describes existing integrated processes for solar cell manufacturing and lists as the primary opportunities for improvement the following areas: low-cost silicon sheets with improved characteristics; improved large-scale and automated solar cell processes that can lead to cell efficiencies in the range of 14 percent (encapsulated) for direct-cast wafers; improved handling and lamination of large-area modules for the emerging utility market. The proposed solutions can lead to finished module costs on the order of $1.55 per square meter or a selling price of less than $2.00/Watt. The problems that may be considered generic to the industry and that have been addressed in this work are as follows: gettering and passivation of silicon wafers; spray-on passivation layers; dual antireflection coatings; ink-jet printing of metallizations; and automated handling of large-area modules and associated vertical lamination. DOE

N92-18905# Colorado State Univ., Fort Collins.
APPLICATIONS OF DIGITAL IMAGE PROCESSING IN WIND ENGINEERING
George Wu, Koji Higuchi, and Robert N. Meroney 1992 13 p
(Contract N00014-88-K-0029; NSF BCS-90-45652)
(AD-A244233; CEP90-91GW-KH-RNM-12) Avail: NTIS HC/MF A03 CSCL 10/1

This paper reviews the application of modern digital image analysis and processing techniques to physical modeling of typical wind engineering flow conditions. Using low-cost conventional image capture hardware and software it is possible to measure flow velocities, turbulence characteristics in turbulent shear layers, or, alternatively, specify instantaneous and average plume dispersion features. GRA

45 ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

N92-18042# Los Alamos National Lab., NM.
SCIENCE, TECHNOLOGY, ENVIRONMENT, AND COMPETITIVENESS IN A NORTH AMERICAN CONTEXT
L. K. Trocki 1991 14 p Presented at the Harmonizing Economic Competitiveness with Environmental Quality: A North American Challenge, Santa Fe, NM, 8-9 Nov. 1991
(Contract W-7405-eng-36)
(DE92-003783; LA-UR-91-3693; CONF-9111147-1) Avail: NTIS HC/MF A03

Most economic activities pollute. Environmental regulations should serve the public good by providing incentives to reduce pollution caused by economic activity. Economic incentives include pollution taxes, subsidies for pollution abatement, and tradeable permits or allowances to pollute. Because of the political unacceptability of taxes and permits, much regulation imposes command and control measures and provides less incentive to minimize pollution. Efficient incentives would encourage pollution abatement up to the point where the cost of abatement equals the social and private benefit from the improvements in the environment. While these costs and benefits are difficult to measure, many analysts contend that the way environmental laws have been formulated and implemented in the U.S. leads to very inefficient pollution control. This inefficiency can contribute to a decline in economic competitiveness in the long run, although economic studies do not support the 'pollution haven' hypothesis. Better analysis (foresight) of the cost of transboundary pollution, significant in the Great Lakes region and along the U.S. - Mexico border, as well as in rivers that flow between countries, is needed to formulate more effective policies and avoid sorry hindsight. Also, application of communal experience, technologies, and methods applied to shared problems can avoid costly duplication of searches for the optimal pollution abatement measures. DOE

N92-18086# Argonne National Lab., IL.
GREENHOUSE GAS EMISSIONS CONTROL BY ECONOMIC INCENTIVES: SURVEY AND ANALYSIS
D. W. South, R. F. Kosobud, and K. G. Quinn 1991 13 p Presented at the 13th Annual North American Conference of the International Association for Energy Economics, Chicago, IL, 18-20 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-004125; ANL/CP-74787; CONF-911184-7) Avail: NTIS HC/MF A03

This paper presents a survey of issues and concerns raised in recent literature on the application of market-based approaches to greenhouse effect policy with an emphasis on tradeable emission permits. The potential advantages of decentralized decision-making cost-effectiveness or allocation efficiency, stimulation of innovations, and political feasibility are discussed. The potential difficulties of data recording, monitoring, enforcement, and of creating viable emission permit contracts and markets are examined. Special attention is given to the problem of designing a greenhouse effect policy that is cost-effective over time: a problem that has been given little attention to date. Proposals to reduce or stabilize greenhouse gas emission (especially CO2) in the short run require high carbon tax rates or permit prices and impose heavy adjustment costs on the fossil fuel industry. A more cost-effective time path of permit prices is proposed that achieves the same long-run climate change stabilization goals. DOE

N92-18146# Tennessee Univ., Knoxville.
AN EVALUATION OF AQUATIC TOXICITY DATA WITH A POPULATION GROWTH MODEL FOR APPLICATION TO ENVIRONMENTAL HAZARD ASSESSMENT Ph.D. Thesis
Willodean Delores Burton May 1991 169 p
(Contract DE-AC05-76OR-00033)
(DE92-004769; DOE/OR-00033/T461) Avail: NTIS HC/MF A08

Acute and chronic bioassays with the cladocerans Ceriodaphnia dubia and Daphnia magna were conducted using four chemicals, each having a different mode of action. The chemicals were: cadmium (chloride), pentachlorophenol (PCP), 1-octanol, and 1-naphthyl-N-methylcarbamate (carbaryl). The data obtained from the tests were used to compare species sensitivities, endpoint sensitivities, and the relative toxicities of the chemicals. In the acute bioassays, estimates of the median lethal concentrations (48-h LC sub 50 S) were used to compare the species sensitivities. Ceriodaphnia dubia was more sensitive than D. magna to all four chemicals, and carbaryl was the most toxic chemical to both species. The sensitivity of three endpoints (survival, reproduction and the intrinsic rate of natural increase, r) were used to evaluate the chronic toxicity of the four chemicals to C. dubia and D. magna. Survival, reproduction and r all declined with greater concentrations of the chemicals. These effects were evident in both the 7 or 14 d exposures. The lowest observed effect concentration (LOEC) determined from studies with the four chemicals showed that neither survival nor reproduction was consistently the more sensitive endpoint for either C. dubia or D. magna. The LOECs for r were the same for both exposure durations for each species. The data from this study demonstrate that the calculations of r from chronic toxicity data can provide equally sensitive bioassay results for protecting the environment, while eliminating conflicting interpretations of toxicant effects on separate endpoints. Furthermore, statistical decisions drawn from comparisons of the toxicity of exposure concentrations with the controls may not provide the most ecologically meaningful criteria for environmental protection. DOE

N92-18155# Argonne National Lab., IL.
TRADEABLE CO2 EMISSION PERMITS FOR COST-EFFECTIVE CONTROL OF GLOBAL WARMING
R. F. Kosobud, D. W. South, T. A. Daly, and K. G. Quinn 1991 14 p Presented at the 13th Annual North American Conference of the International Association for Energy Economics, Chicago, IL, 18-20 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-003519; ANL/CP-74713; CONF-911184-6) Avail: NTIS HC/MF A03

Many current global warming mitigation policy proposals call for large, near-term reductions in CO2 emissions, thereby entailing high initial carbon emission tax rates or permit prices. This paper claims that these high initial tax rates or permit prices are not cost effective in achieving the desired degree of climate change control. A cost effective permit system is proposed and described that, under certain assumptions, would allow markets to optimally lead permit prices along a gradually increasing trajectory over time. This price path presents the Hotelling result and would ease the abrupt, inefficient, and costly adjustments imposed on the fossil fuel and other industries in current proposals. This finding is demonstrated using the Argonne Model, a linear programming 'energy environmental economic' model that allows for intertemporal optimization of consumer energy well being. DOE

N92-18208# Pittsburgh Energy Technology Center, PA.
DESTRUCTION OF ACID GAS EMISSIONS Patent Application
M. P. Mathur, inventor (to DOE), Yuan C. Fu, inventor (to DOE), J. M. Ekmann, inventor (to DOE), and J. M. Boyle, inventor (to DOE) 22 Jun. 1990 16 p
(DE92-003812; US-Patent-Appl-SN-541992;
Patents-US-A7541992) Avail: NTIS HC/MF A03

A method of destroying NO(x) and SO(x) in a combustion gas is disclosed. The method includes generating active species by treating stable molecules in a high temperature plasma. Ammonia, methane, steam, hydrogen, nitrogen or a combustion of these gases can be selected as the stable molecules. The gases are subjected to plasma conditions sufficient to create free radicals, ions or excited atoms such as N, NH, NH2, OH, CH and/or CH2. These active species are injected into a combustion gas at a location of sufficiently high temperature to maintain the species in an active state and permit them to react with NO(x) and SO(x). Typically the injection is made into the immediate post-combustion gases at temperatures of 475 to 950 C. DOE

N92-18287# Lawrence Livermore National Lab., CA.
IMPACT OF REACTIVE NITROGEN EMISSIONS FROM FOSSIL FUEL COMBUSTION AND BIOMASS BURNING ON ATMOSPHERIC CHEMISTRY
J. Dignon, J. E. Penner, C. S. Atherton, and J. J. Walton Sep. 1991 28 p Presented at the International Symposium on Energy and Environment, Espoo, Finland, 25-28 Aug. 1991
(Contract W-7405-eng-48)
(DE92-003544; UCRL-JC-108038-Rev-1; CONF-910809-2-Rev-1)
Avail: NTIS HC/MF A03

In this study, using a Lagrangian chemical transport-deposition model adapted to the nitrogen cycle, we will look at all of the known sources of nitrogen oxides, both natural and man-made. We will attempt to quantify the relative affect that man made sources, including fossil fuel and biomass burning, have had on the nitrogen cycle and the chemistry of the atmosphere throughout the globe. DOE

N92-18331# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Zentrallabor Chemie, Biotechnik.
BIOSENSORS FOR THE DETECTION OF HEAVY METAL IONS AND FECAL CONTAMINATION
Florian Binder, Josef Ritter, Reinhold Hilpert, Stephan Drost, Conrad Koesslinger, Sabine Koch, and Eckart Mueller (Fraunhofer-Inst. fuer Festkoerpertechnologie, Munich, Germany, F.R.) 1991 5 p Presented at the Tagung Biosensoren: Grundlagen, Technologien, Anwendungeng, Bogensee, Finland, 12-14 May 1991
(MBB-0393-91-PUB; ETN-92-90611) Avail: NTIS HC/MF A01

Sensors for the detection of heavy metal ions in waste water and fecal coliforms in surface water are described. Heavy metal complexing peptides/proteins and antibodies against surface antigens of fecal coliforms are used as biological components. As tranducers, Proton Sensitive Field Effect Transistors (PSFET's), mass sensitive piezoelectric crystals, and integrated grating couplers are investigated. ESA

N92-18519# CH2M/Hill, Inc., Sacramento, CA.
STEAM INJECTION/VACUUM EXTRACTION. PHASE 2: TREATABILITY INVESTIGATION, SITE CHARACTERIZATION, AND DESIGN Final Report
Jeff Heglie, Robert Koster, Rob Pexton, and Lloyd Stewart Dec. 1991 319 p
(Contract F04699-90-D-0035; AF Proj. 5018)
(AD-A243745) Avail: NTIS HC/MF A14 CSCL 13/2

The United States Air Force is planning to conduct a pilot test of steam injection and vapor extraction remediation technology at McClellan AFB. This innovative technology, under development by Kent Udell at the University of California at Berkeley, combines in situ steam injection into soil in both the vadose (unsaturated) and saturated zone, with vacuum extraction of volatile and semi-volatile organic contaminants from the soil. Results of the composite soil samples received to date show the presence of dioxins and dibenzofurans, petroleum hydrocarbons, volatile organics, semi-volatile organics, and polychlorinated biphenyls in the waste fill material. Results of the treatability testing indicate that: (1) low concentrations of dioxins and furans were mobilized by the steam condensate; (2) high concentrations of hydrocarbons were reduced by one order-of-magnitude by the steam; and (3) dioxins and furans appear to be dissolved mainly in the hydrocarbon nonaqueous phase liquid (NAPL) phase. Petroleum hydrocarbon and dioxin concentrations are not high enough to preclude a pilot scale test. GRA

N92-18596# Argonne National Lab., IL.
CHRONIC LUNG INJURY RISK ESTIMATES FOR URBAN AREAS HAVING OZONE PATTERNS SIMILAR TO THOSE IN THE NORTHEAST
M. Absil, P. Narducci, R. Whitfield, and H. M. Richmond (Environmental Protection Agency, Research Triangle Park, NC.) 1991 14 p Presented at the Specialty Conference on Tropospheric Ozone and the Environment, Atlanta, GA, 5-7 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-004718; ANL/CP-74664; CONF-911180-1) Avail: NTIS HC/MF A03

This paper describes the approach and result of an assessment of health risks associated with long-term exposure to ozone. The health endpoint of interest is the probability of formation of mild lesions in the centriacinar region of the lung among children living in New York City. The risk model incorporates an exposure model and a health model. The exposure model is preliminary results of the probabilistic NAAQS Exposure Model (P-NEM) for ozone, and the health model is the judgments of active researchers about the likelihood of formation of ozone-induced lesions in the human lung. Children and New York City were chosen as the population and city of interest because it is believed that children are more sensitive to ozone than any other group of people, and New York City is more representative of other urban areas than Los Angeles, the other city of which P-NEM exposure results are available. Risk results are presented for ten exposure distributions generated by P-NEM, two air quality scenarios (as-is and attainment), and two exposure periods (1 and 10 ozone seasons). The results vary across experts, are not very sensitive to variations in P-NEM exposure distributions, are lower for attainment conditions than as-is conditions, and are lower for 1 season of exposure than 10 seasons. Although these results are specific to children living in areas having exposure patterns similar to those found in the Northeast, they are fairly representative of results for outdoor workers in the Northeast and Southern California and for children in Southern California. The reason for this is that many experts believe that children and outdoor workers respond in a similar fashion to the given exposure patterns, or that exposure patterns in the Northeast and Southern California are similar. Some experts held both of these beliefs. These results should help policymakers evaluate alternative national ambient air quality standards for ozone. DOE

N92-18604# Lawrence Livermore National Lab., CA.
GREENHOUSE GASES: SOURCES AND EMISSIONS
J. Edmonds and D. J. Wuebbles 30 Mar. 1991 30 p Presented at the World Coal Institute Conference and Exhibition on Coal in the Environment, London, England, 3-5 Apr. 1991
(Contracts W-7405-eng-48; DE-AC06-76RL-01830)
(DE92-004672; UCRL-JC-108318; CONF-910405-2) Avail: NTIS HC/MF A03

The current interest in the 'greenhouse' issue stems from the observation that the concentrations of such gases as CO2, CH4, N2O, CFCl3, and CF2Cl2 have been increasing. Changes in the concentrations of these gases hold the potential for changing the Earth's climate. In the discussion that follows, we will examine recent and long-term trends in the atmosphere, and the current understanding of the sources of the most important radiatively important gases released as byproducts of human activities. These gases are: CO2, CH4, N2O, CFCs, and CO. In addition, we will discuss the current outlook for future emissions of these gases and the current understanding of the technical potential and economic costs of options to reduce emissions of these gases. This suite of gases includes both the greenhouse gases as well as those gases which can either directly or indirectly affect the Earth's energy balance. DOE

N92-18721# Department of Energy, Washington, DC. Office of Health and Environmental Research.
ATMOSPHERIC SCIENCES PROGRAM: SUMMARIES OF RESEARCH IN FY 1991
Nov. 1991 39 p
(DE92-004111; DOE/ER-0512T) Avail: NTIS HC/MF A03

This document describes the activities and products of the Atmospheric Sciences Program of the Environmental Research, Office of Energy Research, U.S. Department of Energy, in Fiscal Year (FY) 1991. The report is organized into four main sections. Research projects in atmospheric chemistry, atmospheric dynamics and support operations are described. Principal investigators, their institutions, goals, level of effort, and products expected are listed. DOE

N92-18725# Los Alamos National Lab., NM.
GLOBAL SIMULATIONS OF SMOKE FROM KUWAITI OIL FIRES AND POSSIBLE EFFECTS ON CLIMATE
G. A. Glatzmaier, R. C. Malone, and C. Y. J. Kao 1991 7 p Presented at the Conference on Global Climate Change: Its Mitigation Through Improved Production and Utilization of Energy, Los Alamos, NM, 21-24 Oct. 1991
(Contract W-7405-eng-36)
(DE92-005068; LA-UR-91-3950; CONF-9110127-1) Avail: NTIS HC/MF A02

The Los Alamos Global Climate Model has been used to simulate the global evolution of the Kuwaiti oil fire smoke and its potential effects on the climate. The initial simulations were done shortly before the fires were lit in January 1991. They indicated that such an event would not result in a 'Mini Nuclear Winter' as some people were suggesting. Further simulations during the year suggested that the smoke could be responsible for subtle regional climate changes in the spring such as a 5 degree centigrade decrease in the surface temperature in Kuwait, a 10 percent decrease in precipitation in Saudi Arabia and a 10 percent increase in precipitation in the Tibetan Plateau region. These results are in qualitative agreement with the observations this year. DOE

N92-18963# Oregon State Univ., Corvallis. Dept. of General Science.
EVALUATING THE UTILITY OF NATURAL VEGETATION IN ASSESSING ARCTIC ACCUMULATION OF AIR TOXICS Final Report
M. V. Santelmann 7 May 1991 155 p Sponsored in part by Corvallis Environment Research Lab., OR
(PB92-103464; EPA/600/3-91/055) Avail: NTIS HC/MF A08 CSCL 13B

Accumulation of toxic, airborne pollutants in the arctic and subarctic is of growing concern to scientists. Levels of atmospheric deposition of these elements in the arctic prior to anthropogenic augmentation of their cycling are unknown, and in many cases, current concentrations of these elements in surface vegetation and their rates of deposition in the arctic are also unknown. The purpose is to provide species-specific information on the use of natural vegetation to monitor trace-metal deposition and accumulation in high-latitude regions of North America. Data will help in research design for arctic contamination studies because they aid in estimating expected concentration ranges between and within-site variability of element concentrations in vegetation samples. Author

N92-18964*# North Carolina State Univ., Raleigh. Dept. of Chemical Engineering.
HETEROGENEOUS PHOTOCATALYTIC OXIDATION OF ATMOSPHERIC TRACE CONTAMINANTS Semiannual Progress Report No. 2, 1 May - 1 Nov. 1991
David F. Ollis and Jose Peral 7 Feb. 1992 50 p
(Grant NAG2-684)
(NASA-CR-189946; NAS 1.26:189946) Avail: NTIS HC/MF A03 CSCL 13B

A two year study to examine the feasibility of using heterogeneous photocatalysis for spacecraft air purification was begun at North Carolina State University on November 1, 1990. The original grant proposal included examination of the rates of destruction of anticipated spacecraft-generated air contaminants, including alcohols, aldehydes, chlorinated compounds, as well as

trace levels of volatile compounds containing nitrogen, sulfur, and silicon. The progress made in the second six month period of 5/1/91-11/1/91 is discussed. Author

46 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism.

For space radiation see *93 Space Radiation.*

N92-18118*# Lockheed Missiles and Space Co., Palo Alto, CA. Space Sciences Lab.

EARTH'S EXTERNAL MAGNETIC FIELDS AT LOW ORBITAL ALTITUDES Final Report, 18 May 1988 - 18 May 1990

D. M. Klumpar May 1990 48 p

(Contract NAS5-30514)

(NASA-CR-189255; NAS 1.26:189255; LMSC-F47064) Avail: NTIS HC/MF A03 CSCL 04A

Under our Jun. 1987 proposal, Magnetic Signatures of Near-Earth Distributed Currents, we proposed to render operational a modeling procedure that had been previously developed to compute the magnetic effects of distributed currents flowing in the magnetosphere-ionosphere system. After adaptation of the software to our computing environment we would apply the model to low altitude satellite orbits and would utilize the MAGSAT data suite to guide the analysis. During the first year, basic computer codes to run model systems of Birkeland and ionospheric currents and several graphical output routines were made operational on a VAX 780 in our research facility. Software performance was evaluated using an input matchstick ionospheric current array, field aligned currents were calculated and magnetic perturbations along hypothetical satellite orbits were calculated. The basic operation of the model was verified. Software routines to analyze and display MAGSAT satellite data in terms of deviations with respect to the earth's internal field were also made operational during the first year effort. The complete set of MAGSAT data to be used for evaluation of the models was received at the end of the first year. A detailed annual report in May 1989 described these first year activities completely. That first annual report is included by reference in this final report. This document summarizes our additional activities during the second year of effort and describes the modeling software, its operation, and includes as an attachment the deliverable computer software specified under the contract. Author

N92-18464# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

AN OBSERVATIONAL STUDY OF THE ENERGETICS AND EFFICIENCY OF BAROCLINIC WAVES IN THE SOUTHERN HEMISPHERE Thesis

Rosa deFatima Cruz Marques Jul. 1991 108 p In PORTUGUESE; ENGLISH summary

(INPE-5307-TDI/457) Avail: NTIS HC/MF A06

Observed characteristics of medium-scale (wave numbers 4-7) baroclinic waves which dominate the summer atmosphere are studied. The efficiencies of baroclinic eddies in transporting heat and momentum are also studied. The correlation coefficients between meridional wind and temperature and meridional wind and zonal wind measure the efficiencies of heat and momentum transport respectively. The wave becomes efficient in transporting heat approximately one day before attaining maximum kinetic energy. Barotropic decay of the wave is associated with higher efficiency of momentum. The energetics of medium-scale waves are calculated using the Saltzman equations. Energy calculations show well defined life cycles with baroclinic growth, maturity, and barotropic decay. The term of conversion between potential energies and kinetic energies omega'alpha' is also calculated. Finally, the validity of geostrophic and hydrostatic approximations is examined. It is found that the geostrophic errors are more in the case of momentum transport than in the case of sensible heat transport. Author

N92-18753*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.

GEOPOTENTIAL MODELS OF THE EARTH FROM SATELLITE TRACKING, ALTIMETER AND SURFACE GRAVITY OBSERVATIONS: GEM-T3 AND GEM-T3S

F. J. Lerch, R. S. Nerem, B. H. Putney, T. L. Felsentreger, B. V. Sanchez, S. M. Klosko, G. B. Patel, R. G. Williamson, D. S. Chinn, and J. C. Chan (Hughes STX, Inc., Lanham, MD.) et al Jan. 1992 124 p

(NASA-TM-104555; Rept-92B00037; NAS 1.15:104555) Avail: NTIS HC/MF A06 CSCL 08G

Improved models of the Earth's gravitational field have been developed from conventional tracking data and from a combination of satellite tracking, satellite altimeter and surface gravimetric data. This combination model represents a significant improvement in the modeling of the gravity field at half-wavelengths of 300 km and longer. Both models are complete to degree and order 50. The Goddard Earth Model-T3 (GEM-T3) provides more accurate computation of satellite orbital effects as well as giving superior geoidal representation from that achieved in any previous GEM. A description of the models, their development and an assessment of their accuracy is presented. The GEM-T3 model used altimeter data from previous satellite missions in estimating the orbits, geoid, and dynamic height fields. Other satellite tracking data are largely the same as was used to develop GEM-T2, but contain certain important improvements in data treatment and expanded laser tracking coverage. Over 1300 arcs of tracking data from 31 different satellites have been used in the solution. Reliable estimates of the model uncertainties via error calibration and optimal data weighting techniques are discussed. Author

N92-18885# MBC Applied Environmental Sciences, Inc., Costa Mesa, CA.

FEDERAL ARCTIC RESEARCH INFORMATION WORKSHOP: WORKSHOP PROCEEDINGS

Joy Geiselman, ed. and Kathryn L. Mitchell, ed. Jul. 1991 130 p Workshop held in Anchorage, AK, 19-21 Mar. 1991

(Contract DI-14-35-0001-30570)

(PB92-110709; OCS/MMS-91/0053) Avail: NTIS HC/MF A07 CSCL 08E

The Federal Arctic Research Information Workshop was organized on behalf of the Inter-Agency Arctic Research Policy Committee (IARPC) in order to facilitate the exchange of information on Federal research to fulfill the intent of the Arctic Research and Policy Act of 1984. The workshop was held on 19-21 Mar. 1991, and representatives from Federal agencies were invited to report on recent accomplishments of research and related activities and to exchange information on current and future projects and programs. The various Federal agencies included the Departments of Agriculture, Commerce, Defense, Energy, Health and Human Services, Interior, and Transportation. The Environmental Protection Agency, NASA, National Science Foundation, and the Smithsonian Institution also presented papers. Author

47 METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

N92-18432# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

VARIABILITY OF RAINFALL IN THE EAST COAST OF THE NORTHEASTERN BRAZIL REGION Thesis

Marley Cavalcante deLima Jun. 1991 244 p In PORTUGUESE; ENGLISH summary

(INPE-5283-TDI/453) Avail: NTIS HC/MF A11

A study is made of the climatological features of rainfall over ENE Brazil. In terms of the spatial distribution, the period of May to June represents the rainy season with 30 pct. of annual rain. From April to July, 60 pct. of the annual rain falls. The large interannual variation of rain is a typical characteristic of this region. Some of the processes responsible for this variation are: (1) the position and intensity of the high pressure system in the South

Atlantic, as revealed by the surface wind variations over Ilha de Trindade and Abrolhos; (2) the occurrence or absence of El Nino, as given by the Southern Oscillation Index (SOI); and (3) the sea surface temperature (SST) variation over the Subtropical Atlantic. It is found that the SOI does not correlate well with the interannual rainfall variation over ENE Brazil. The surface wind over Ilha de Trindade and Abrolhos correlates well with the interannual variation of rainfall over this region. This shows that the intensity and position of the Subtropical High have a controlling influence on the rain. The high values of lagged correlation between the surface wind over these two stations and the rain over ENE Brazil suggests the utility of this for long range forecasting of rain over this region. The relationship between the SST over Tropical Atlantic and the rain shows that a dipole type configuration with higher (lower) temperatures in the South (North) Atlantic is favorable for higher (lower) rain. Although this is qualitatively similar to that noted by Hastenrath-Heller and Moura-Shukla, the details of the centers of higher correlation are different. Author

N92-18434# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

NUMERICAL SIMULATION OF FRONTOGENESIS Thesis

Nivaldo Silveira Ferreira Apr. 1991 92 p In PORTUGUESE; ENGLISH summary

(INPE-5266-TDI/442) Avail: NTIS HC/MF A05

Numerical simulations of frontogenesis were performed using a limited area multilevel numerical model. The frontogenetical forcing was represented by horizontal deformation flow. The numerical experiments were run with and without the release of latent heat. In both experiments, the frontogenesis at low levels and a jet at high levels, along the front to the left side of the surface frontogenesis position, were generated. The frontogenesis and the vertical motion became more intense with the inclusion of the release of latent heat, enhancing the mass convergence in the frontogenetical region. Author

N92-18435# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

THE CONDITIONAL SYMMETRIC INSTABILITY AND THE FORMATION OF RAINBANDS OVER THE STATE OF SAO PAULO, BRAZIL Thesis

Ana Maria Bueno Nunes 1991 146 p In PORTUGUESE; ENGLISH summary

(INPE-5267-TDI/443) Avail: NTIS HC/MF A07

The Conditional Symmetric Instability (CSI) and the necessary conditions for its detection is examined. The methods are considered for its evaluation and its possible relationship with rainband cases over the State of Sao Paulo, Brazil. The analyses are done from radiosondes and weather radar maps. Results show that organization of moderate to heavy precipitation bands, between 30 to 70 km wide, known as 'wide rainbands', can be associated to the presence of a shallow layer (in the middle or upper troposphere), with potential instability likely generated by CSI. The underlying air is generally conditionally stable or nearly neutral. The most simple way of determining CSI is attained by assessing the 'Slantwise Convective Available Potential Energy' (SCAPE) from a single atmospheric sounding. It is observed that there is SCAPE greater than or = 0 for 85 pct. of the rainband sample. Author

N92-18436# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

SIMULATIONS OF THE SUMMER ATMOSPHERIC CIRCULATION OVER SOUTH AMERICA WITH THE INCLUSION OF ANDES TOPOGRAPHY USING eta COORDINATE Thesis

Silvio Nilo Figueroa Dec. 1990 102 p In PORTUGUESE; ENGLISH summary

(INPE-5269-TDI/445) Avail: NTIS HC/MF A06

A multilevel primitive equation model with eta coordinate is developed and is used to study the atmospheric circulation of the Andes mountains on the regional atmospheric circulation generated by the summer tropical thermal forcing situation in central Brazil and southern Amazonia. With and without the inclusion of the mountain, the model reproduces the essential summer circulation characteristics such as the Bolivian High and the Northeast Brazil upper troposphere trough. It is found that the Andes mountains favor the formation of a low level, elongated region of convergence with a NW-SE orientation, in approximately the same position as the South Atlantic Convergence Zone (SACZ). These results suggest that the release of latent heat due to convection over central Brazil is an important role in placing the SACZ in its observed mean position. With the inclusion of the Andes, the model also reproduces some aspects of the 'Chaco Low' such as its positioning in northern Argentina. The model results suggest the existence of a strong interaction between the Pacific westerlies in the upper levels and circulation of the Bolivian High generated by the thermal forcing, principally near its southern boundary. Author

N92-18437# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

INTER-HEMISPHERIC EFFECTS OF STRONG TROPICAL HEAT SOURCES Thesis

Dirceu Luis Herdies Jun. 1991 142 p In PORTUGUESE; ENGLISH summary

(INPE-5272-TDI/447) Avail: NTIS HC/MF A07

The response over South America of the latent heat release in a strong perturbation (hurricane) moving over North Tropical Atlantic Ocean (NTAO) is studied using a nonlinear semi-Lagrangian two layer primitive equation model. The model results show that such a perturbation propitiates a coupling with frontal system in the Southern Hemisphere and the convective explosion occurring over Central Brazil and West Amazon. As the disturbance moves to northwest in the NTAO, the northwesterlies high levels become more intense along the north coast of Brazil, as opposed to the typically observed circulation during hurricane season (Aug. to Oct.). Meanwhile, a well defined low pressure center appears over Central, North, and Northwest Brazil. The results also show the importance of nonlinear terms in the dynamic evolution of the phenomenon: the strong shear inhibits the local and inter-hemispheric response, it occurs in the case of hurricane on the basic state with a strong anticyclonic vorticity. These nonlinear effects can be related to the divergence and vertical advection in the vorticity equation. Author

N92-18443# Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.

AN OBSERVATIONAL ANALYSIS OF THE ZONAL WIND FIELDS OF SHARPLY RECURVING, SLOWLY RECURVING, AND NON-RECURVING CYCLONES

Stephen J. Hodanish 1991 6 p Sponsored by ONR

(AD-A242848) Avail: NTIS HC/MF A02 CSCL 04/2

Environmental wind fields of recurving and non-recurving tropical cyclones were examined to: (1) observe how the wind fields associated with non-recurving cyclones differ from those with recurving cyclones prior to beginning recurvature and; (2) observe how synoptic scale wind fields interact with the circulation of recurving cyclones 1 to 2 days prior to the beginning of recurvature. Author

N92-18506# International Centre for Theoretical Physics, Trieste (Italy).

STABLE METHODS FOR ILL-POSED PROBLEMS AND APPLICATION TO RECONSTRUCTION OF ATMOSPHERIC TEMPERATURE PROFILE

H. H. Son, P. T. Luong, and N. T. Loan (National Center for Scientific Research of Vietnam, Hanoi.) Apr. 1990 22 p

(DE92-604952; IC-90/45) Avail: NTIS HC/MF A03

The problems of remote sensing (passive or active) are investigated on the base of main principle which consists of the interpretation of radiometric electromagnetic measurements in such a spectral interval where the radiation is sensitive to interested physical property of medium. Those problems, such as an analysis of composition and structure of atmosphere using the records of scattered radiation, cloud identification, investigation of thermodynamic state and composition of system, and

reconstructing the atmospheric temperature profile on the base of data processing of infrared radiation emitted by system Earth Atmosphere, belong to a class of inverse problems of mathematical physics which are often incorrect. In this paper, a new class of regularized solution corresponding to general formulated RATP-problems is considered. DOE

N92-18681# International Centre for Theoretical Physics, Trieste (Italy).
SOUTHERN HEMISPHERE CIRCULATION SIGNALS IN CONNECTION WITH WINTER RAINFALL FORECASTING IN CENTRAL CHILE
J. Rutlant and P. Aceituno (Chile Univ., Santiago.) May 1991 20 p
(DE92-604953; IC-91/64) Avail: NTIS HC/MF A03

The possibility of detecting easterly propagating low frequency signals in the Southern Hemispheric circulation is explored in connection with the assessment of a possible seasonal rainfall forecast in central Chile. The analysis has focused on the seasonal variability associated with the biennial component of the Southern Oscillation (SO) and on the one resulting from superimposed intraseasonal oscillations, in relation with winter precipitation and individual rainfall events, respectively. Based on a previous work, relating wet winters to frequent blocks to the SW of South America during warm events of the SO, time-longitude cross sections of a 5-day average blocking index (BI) calculated from ECMWF 200 hPa daily hemispheric analyses for the period 1980 to 1987 are presented. A general eastward displacement of western and central Pacific positive BI areas seems to characterize the developing phase of warm SO events and vice versa, while intraseasonal variability patterns appear to be related to single rainstorms, either when the positive BI phase of the wave amplifies while crossing the western Pacific or when it reaches the far southeastern Pacific, frequently with a double block structure. It is concluded that the behavior of both sources of variability is consistent with previously described teleconnection patterns for ENSO events in the southern winter, and that a primary prospect for winter precipitation and for the occurrence of relatively large individual rainstorms in central Chile could be obtained following the filtered BI and 500 hPa height anomalies in both time scales during the fall season. DOE

N92-18763# National Oceanic and Atmospheric Administration, Boulder, CO. Wave Propagation Lab.
CALIBRATION OF INFRARED RADIOMETERS FOR CLOUD-BASE TEMPERATURE REMOTE SENSING: TECHNIQUE AND ERROR ANALYSIS
J. A. Shaw Aug. 1991 23 p
(PB92-102755; NOAA-TM-ERL-WPL-207) Avail: NTIS HC/MF A03 CSCL 04B

Absolute radiometric calibration is required for ground-based infrared remote sensing of cloud-base temperature. This requires associating the radiometer's output voltage with blackbody temperatures over the desired measurement range. Insufficient attention to suble error sources while performing this conceptually simple calibration results in errors many times larger than 1.0 C uncertainty achievable with a carefully performed calibration. Inadequate blackbody simulation and imprecise voltage measurements contribute most significantly to calibration uncertainty. The purpose is documentation and error analysis of the technique used at the NOAA Wave Propagation Laboratory for calibrating zenith-viewing infrared radiometers. Additional uncertainties that arise in cloud-based temperature measurements for real clouds in the real atmosphere are briefly discussed. GRA

N92-18823# California Univ., Davis.
ATMOSPHERIC TURBULENCE STRUCTURE AT THREE VEGETATED SITES Final Report, 1 Aug. 1989 - 31 Jul. 1991
Roger H. Shaw 3 Dec. 1991 21 p
(Contract DAAL03-89-K-0135)
(AD-A244303; ARO-27019.1-GS) Avail: NTIS HC/MF A03 CSCL 04/2

Atmospheric turbulence immediately above and within vegetation has features that distinguish it from that observed over smooth terrain. A variety of statistical properties demonstrate these differences, which are believed to be reflections of organized motions. The study involved the analysis of four data sets: a deciduous forest, an almond orchard, a maize crop, and an English walnut orchard. Statistics included skewness, spectra, correlation coefficients, lagged correlations, and quadrant analysis. Overall, normalized statistics were remarkably similar for all four stands when vertically scaled by the height of the top of the vegetation, despite the large differences in the dimensions and vegetative structures of the stands. Objective schemes were used to detect ramp patterns in data from each site. Applied to the forest data, the multilevel scheme showed that a consistent number of ramps was detected in the humidity traces during each run, despite the fact that thermal stability changed during the observation period. Comparing the four canopies, the frequency of occurrence of ramps increased as stand height decreased. A consistent relationship was found when the frequency was plotted against a measure of the wind shear. It is demonstrated that the wavelet technique accurately detects scalar ramps. GRA

N92-18891# International Centre for Theoretical Physics, Trieste (Italy).
STATES AND INTER-STATE SWITCHING IN METEOROLOGICAL PARAMETERS
E. C. Njau Nov. 1990 24 p
(DE92-604951; IC-90/396) Avail: NTIS HC/MF A03

We show theoretically and also through actual records that variations in air/surface temperature and associated meteorological parameters take place in three different states termed 'state 1', 'state 2', and 'state 3'. For a given place, one of the two states (i.e. states 1 and 2) is accompanied by high (or increasing) rainfall while the other state is accompanied by relatively small (or decreasing) rainfall. Systematic switching from one state to another does take place at several places under physical conditions detailed in the text. Available evidence indicates that inter-state switching between states 1 and 2 is primarily caused by the 11-year solar cycle and some of those other cycles responsible for variations in the solar energy incident onto the earth-atmosphere system. Finally, it is shown that one of the possible causes of double sunspot cycle variations in meteorological parameters is inter-state switching between state 1 and state 2. This conclusion is both consistent with and supported by past observations. DOE

N92-18911# World Meteorological Organization, Geneva (Switzerland).
COMMISSION FOR AERONAUTICAL METEOROLOGY. ABRIDGED FINAL REPORT OF THE NINTH SESSION
1991 182 p Session held in Montreal, Quebec, 5-28 Sep. 1990
(WMO-752; ISBN-92-63-10752-1; ETN-92-90660) Copyright
Avail: NTIS MF A01; HC availaible from WMO, Case Postale No. 5, CH-1211 Geneva 20, Switzerland

Various aspects of aeronautical meteorology are addressed. Training of aeronautical meteorological personnel, publications and guidance material, and cooperation with other international organizations are discussed. The resolutions and recommendations of the commission are presented. These include recommendations from the advisory working group of the commission, from the working group on advanced techniques, and from the working group on the provision of meteorological information required before and during flight. A complete list of participants is listed in the annex. ESA

N92-18912# World Meteorological Organization, Geneva (Switzerland).
[ACTIVITIES REPORT OF THE WORLD METEOROLOGICAL ORGANIZATION] Annual Report, 1990
1991 74 p
(WMO-746; ISBN-92-63-10746-7; ETN-92-90661) Copyright
Avail: NTIS MF A01; HC availaible from WMO, Case Postale No. 5, CH-1211 Geneva 20, Switzerland

The activities, conferences, research projects, and publications of the World Meteorological Organization (WMO) during the course of 1990 are described. The organization structure and funding of the organization are presented. The World Climate Program and the World Weather Watch Program are described. The global climate system and significant climate anomalies and events during 1990 are described. One of these anomalies is the El Nino Southern Oscillation. Other more localized anomalies and events are reported. All six of the warmest years in global record have occurred since 1980. ESA

N92-18932# Massachusetts Inst. of Tech., Lexington. Lincoln Lab.
MICROBURST DIVERGENCE DETECTION FOR TERMINAL DOPPLER WEATHER RADAR (TDWR)
M. W. Merritt 25 Sep. 1991 174 p
(Contracts DTFA01-85-Z-02033; F19628-90-C-0002)
(AD-A243808; ATC-181; DOT/FAA/NR-91/7) Avail: NTIS HC/MF A08 CSCL 17/9

The Terminal Doppler Weather Radar (TDWR) microburst surface divergence detection algorithm has been under development and evaluation at Lincoln Laboratory since 1983. The TDWR program is sponsored by the Federal Aviation Administration (FAA), and the algorithm described in this report is a primary algorithm component of the TDWR system. The divergence algorithm processes radar velocity measurements taken near the earth's surface to identify the strong divergent outflow characteristic of microburst wind shear hazards. The algorithm uses a complex set of pattern matching and validation test criteria to locate microburst outflow signatures and to filter out false alarms from various data contamination sources. The divergence algorithm is primarily responsible for the detection of most microbursts, although the complete TDWR microburst algorithm consists of more than a dozen distinct algorithmic components. The divergence algorithm has demonstrated a very high probability of detection (POD) for strong microburst outflows, and its performance (as well as that of the complete microburst detection algorithm) was first formally assessed in the operational test and evaluation of the TDWR in Denver, CO (1988). Subsequent evaluations were performed in Kansas City, KS (1989) and Orlando, FL (1990). These evaluations have provided insight into the algorithm and system performance in a variety of meteorological and geographical environments. GRA

48 OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources.

For related information see also *43 Earth Resources and Remote Sensing.*

N92-18089# Manchester Univ. (England). Aeronautical Engineering Group.
MODELLING OF INTERFACIAL AND THERMOCLINE WAVES
Quarterly Progress Report No. 3
F. A. Paonessa, D. Nicolaou, and T. N. Stevenson 1 Jul. 1990 19 p
(Contract MOD-2052/88/Space(F))
(Aero-Rept-9006; ETN-92-90923) Avail: NTIS HC/MF A03

Progress in experimental and numerical investigations is reported. A towing tank and trolley are in use and a schlieren system is arranged to obtain plan views of the wave system. The instrumentation and computer system will record up to 24 inputs with a 12 bit accuracy. The first finite difference program with a three dimensional rectangular body moving in an enclosed tank was completed. It is possible to use any density distribution. The program was run with a haline/thermocline at mid depth. Some examples of the results obtained when a body moves below a haline are shown. ESA

N92-18234# Manchester Univ. (England). Aeronautical Engineering Group.
MODELLING OF INTERFACIAL AND THERMOCLINE WAVES
Quarterly Progress Report No. 4
D. Nicolaou, F. A. Paonessa, and T. N. Stevenson 1 Oct. 1990 41 p
(Contract MOD-2052/88/Space(F))
(Aero-Rept-9011; ETN-92-90928) Avail: NTIS HC/MF A03

Ray theory is used to derive the equations for the wave patterns produced when a body accelerates from rest or moves with constant speed in a stratified fluid which has a pycnocline or thermocline of finite thickness; a region in which there is a peak in the buoyancy frequency. The equations are derived from a dispersion relation based on a tank density profile. All modes of oscillation can be determined. It is shown that for the n = 0 mode both oblique and transverse waves occur whereas for the greater than 0 modes the presence of transverse waves depend on the background conditions and on the speed of the body. For the case when a body is started impulsively from rest, the impulsive start waves are also determined. The wave patterns from small amplitude wave theory compare quite well with finite difference calculations of the full Navier-Stokes equations. ESA

N92-18340# Manchester Univ. (England). Aeronautical Engineering Group.
MODELLING OF INTERFACIAL AND THERMOCLINE WAVES
Progress Report No. 2
F. A. Paonessa and D. Nicolaou 30 Mar. 1990 16 p
(Contract MOD-2052/88/Space(F))
(Aero-Rept-9004; ETN-92-90921) Avail: NTIS HC/MF A03

Progress in experimental and numerical investigations is reported. The construction of the towing tank is at an advanced stage. With regard to the instrumentation, trial programs were written for the analog to digital input boards to receive data from the conductivity probes to establish the maximum frequency of data sampling that can be obtained and also the maximum amount of data that can be stored on a given run. The interaction between a periodic 'mean current' induced by internal waves and short surface, a mechanism leading to variations in sea surface roughness, was investigated. A method of overcoming the restriction on the free surface movement is described and preliminary results are given. ESA

N92-18461# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
EQUATORIAL OCEAN CIRCULATION PROBLEMS: DETERMINATION OF THE HORIZONTAL STRUCTURE OF THE BAROCLINIC MODES BY BOUNDARY INTEGRAL EQUATIONS
Thesis
Paulo Renato Centeno Holvorcem Apr. 1991 250 p In PORTUGUESE; ENGLISH summary
(INPE-5309-TDI/459) Avail: NTIS HC/MF A11

A detailed presentation of a methodology for the numerical simulation of tropical ocean circulation is given. Specifically, the linearized shallow water equations on the equatorial beta-plane are considered, which may be used to describe the horizontal dependence of each baroclinic mode in a vertical normal mode expansion. A general boundary value problem for these equations, with slip boundary conditions applied at a boundary of arbitrary geometry, is reformulated as a boundary integral equation for the unknown boundary pressure distribution. In this way, the integral equations describing both the wind-forced circulation and the scattering of free equatorial waves by islands and continental margins of arbitrary geometry can be obtained. The kernels of the integral operators appearing in the boundary integral equations are analytically represented as expansions in free equatorial waves involving the Hermite functions psi sub m (y), where y is the nondimensional latitude. In certain cases, it is convenient to compute the kernels through these expansions, because of their slow convergence. Physically, this arises from the superposition of equatorial waves with complex wavenumbers. A general theory is developed for the asymptotic evaluation of the remainder of a Hermite expansion, when the series is truncated after a sufficiently

large number of terms. This theory , which is applicable to a variety of oceanographically relevant expansions, allows the efficient numerical computation of the kernels of the integral operators. Procedures for the numerical solution of the boundary integral equations by the boundary element method are developed and implemented in a set of routines in FORTRAN 77. The new methodology is illustrated by a study of the scattering of equatorial Rossby waves with periods between 50 and 90 days by the western Atlantic Boundary. Some of the resulting interference patterns exhibit a region of large amplitudes of oscillation, whose center is located between 3-9 degrees N, 35-47 degrees W. Evidence is found that this effect arises from the constructive interference of zonally damped modes which are excited south of the equator at the ocean boundary. Author

51 LIFE SCIENCES (GENERAL)

N92-18113# Rensselaer Polytechnic Inst., Troy, NY.
PHYLOGENETIC RELATIONSHIPS AMONG SUBSURFACE MICROORGANISMS
S. A. Nierzwicki-Bauer 1991 10 p
(Contract DE-FG02-90ER-60989)
(DE92-004421; DOE/ER-60989/2) Avail: NTIS HC/MF A02

This project involves the development of group specific 16S ribosomal RNA-targeted oligonucleotide hybridization probes for the rapid detection of specific types of subsurface organisms (e.g., groups of microbes that share certain physiological traits). Major accomplishments for the period of 6/91 to 12/1/91 are described. Nine new probes have been synthesized on the basis of published 16S rRNA sequence data from the Ribosomal Database Project. We have initiated rapid screening of many of the subsurface microbial isolates obtained from the P24 borehole at the Savannah River Site. To date, we have screened approximately 50 percent of the isolates from P24. We have optimized our hybridization technique, and have developed a cell blot hybridization technique to screen 96 samples on a single blot. This is much faster than reading 96 individual slides. Preliminary experiments have been carried out which indicate specific nutrients can be used to amplify rRNA only in those organisms capable of metabolizing those nutrients. DOE

N92-18132# International Centre for Theoretical Physics, Trieste (Italy).
ON THE TRANSITION PERIOD FROM CHEMICAL TO BIOLOGICAL EVOLUTION
J. Chela-Flores Jun. 1991 11 p
(DE92-609049; IC-91/127) Avail: NTIS HC/MF A03

We discuss the consequences of the hypothesis that biological evolution was contemporary with an important event in chemical evolution, namely, the induction of a small chiral bias by the electroweak neutral interaction, amplified by the Salam enhancement factor, which we discuss in terms of familiar crystallographic terms. DOE

N92-18257# University of Southern Illinois, Springfield. School of Medicine.
THE EFFECTS OF EXERCISE ON PHARMACOKINETICS AND PHARMACODYNAMICS OF PHYSOSTIGMINE IN RATS Final Report, 16 Nov. 1987 - 15 Aug. 1990
S. M. Somani, P. Buckenmeyer, M. DaSilva, S. N. Dube, and L. Fitzpatrick 15 Feb. 1991 148 p
(Contract DAMA17-88-C-8024)
(AD-A241867) Avail: NTIS HC/MF A07 CSCL 06/5

This report deals with the effect of acute and trained exercise on pharmacodynamics (cholinesterase activity), pharmacokinetics and biochemical parameters in the rat after physostigmine (Phy) administration. Dose-response studies of Phy and ChE inhibition in vivo indicated that a dose of 70 micrograms/kg of Phy inhibited about 30 percent of ChE activity in RBC. This dose was used throughout these exercise studies in consultation with USAMRDC. The oxygen consumption, respiratory exchange ratio (RER) and heat production showed a positive linear relationship in young and adult rats at different levels of exercise. However, significant differences were found in oxygen consumption and caloric expenditure in young vs. adult rats. Different levels of acute exercise affect the ChE activity in RBC and heart and alter the Phy-induced ChE activity in RBC and the brain. GRA

N92-18757# International Centre for Theoretical Physics, Trieste (Italy).
GLOBAL MODELS FOR THE BIOMECHANICS OF GREEN PLANTS, PART 2
A. R. Bestman Dec. 1990 8 p
(DE92-603590; IC-90/474-Pt-2) Avail: NTIS HC/MF A02

This paper examines the situation when the flow is not fully developed while the aspect ratio may not be small. Even for the low Reynolds situation, the problem is now nonlinear. Analytical solutions for the problem are found by asymptotic approximation. The method makes use of finite Fourier cosine and sine transforms. These solutions are discussed quantitatively. DOE

N92-18758# International Centre for Theoretical Physics, Trieste (Italy).
GLOBAL MODELS FOR THE BIOMECHANICS OF GREEN PLANTS, PART 3
A. R. Bestman Dec. 1990 9 p
(DE92-603591; IC-90/475-Pt-3) Avail: NTIS HC/MF A02

As a result of dehydration, there are daily changes in the stem diameter of green plants. This transient phenomenon is addressed in this paper. It is assumed that a small time perturbation is superimposed on an otherwise constant radius. By employing the Laplace transforms, analytical solutions are developed for this peculiar phenomenon. These results are discussed quantitatively. DOE

N92-18887# California Univ., Berkeley.
MECHANISMS OF ACTION OF HEAVY METALS AND ASBESTOS ON CULTURED ANIMAL CELLS: ADAPTATION, TRANSFORMATION AND PROGRESSION
H. Rubin 1991 131 p
(Contract DE-AS03-79EV-10277)
(DE92-004101; DOE/EV-10277/T2) Avail: NTIS HC/MF A07

Living organisms are exposed to and affected by a variety of physical and chemical environmental factors. Among these are a number of chemical agents which seriously modify the normal functioning and growth of biological systems. The general purpose of this project was to determine some of the effects of several important chemicals on living cells and to investigate the molecular mechanisms whereby these external agents affected cellular structure, physiology, metabolism, and growth. Our focus was on several environmental constituents, including asbestos and the heavy metals cadmium, mercury, lead, and nickel, which gave both short-term and long-term effects on various organisms and consequently are of serious public health concern. DOE

N92-18974# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
BUBBLE NUCLEATION THRESHOLD IN DECOMPLEMENTED PLASMA
C. A. Ward, D. Yee, D. McCullough, and W. D. Fraser (Defence and Civil Inst. of Environmental Medicine, North York, Ontario) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p Sponsored in part by Defence and Civil Inst. of Environmental Medicine, North York, Ontario (For primary document see N92-18972 09-52)
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N92-18982# Air Force Systems Command, Brooks AFB, TX. Crew Technology Div.
HEMODYNAMIC RESPONSES TO PRESSURE BREATHING DURING +Gz (PBG) IN SWINE
J. W. Burns, J. W. Fanton, and J. L. Desmond *In* AGARD, High

Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)
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52 AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

N92-18025# Oakland Univ., Rochester, MI.
MECHANISMS FOR RADIATION DAMAGE IN DNA
M. D. Sevilla Dec. 1991 27 p
(Contract DE-FG02-86ER-60455)
(DE91-019080; DOE/ER-60455/6) Avail: NTIS HC/MF A03

Recent work in our laboratory has been instrumental in the reformulation of the current model for radiation damage in DNA. We have found that radical ion distribution is a function of strandedness of the DNA. A new model for ion transport through DNA is proposed. We completed an extensive ab initio molecular orbital study of the ion radicals species envolved in DNA radiation damage. In this effort, the ionization energies (IE), electron affinities (EA), relative energies, fully optimized structural parameters, and spin densities were determined. Joint work with Steven Swarts and Ken Wheeler of Wake Forest on yields of products on irradiation of DNA has also yielded new insights to radiation damage to DNA - specifically, the division between the direct and indirect effect. Perhaps our most important work during this period has been in the area of the interaction of thiyl radicals and oxygen as well as (DNA) peroxyl radicals with thiols. The sulfinyl radical, RSO*, was not previously known to be a product of thiol- or carbon-based peroxyl reaction with RSH. The structure of the thiyl peroxyl radical, RSOO, was uncertain. The conversion of RSOO to the sulfonyl radical, RSO2, and the subsequent reaction with oxygen to form the sulfonyl peroxyl radical, RSO2OO, had never been suggested in the literature. We have investigated the reactions of thiols with primary ion radicals in gamma-irradiated DNA and observed electron transfer from the thiol to the guanine cation radical. This is believed to be the major protective effect of thiols from the direct effect of radiation. Our work with peroxyl radicals has also established that the ESR measured O-17 hyperfine couplings give a good estimate of the relative reactivity of the peroxyl group and shows that the thiol peroxyl radical cannot be a effective hydrogen abstracting agent. DOE

N92-18076# Army Biomedical Research and Development Lab., Fort Detrick, MD.
TECHNOLOGY ASSESSMENT AND STRATEGY FOR DEVELOPMENT OF A RAPID FIELD WATER MICROBIOLOGY TEST KIT
David R. Preston and Stephen A. Schaub Sep. 1991 54 p
(AD-A243413; USABRDL-TR-9106) Avail: NTIS HC/MF A04
CSCL 06/6

A literature and market search of existing technology for the detection, identification, and quantification of microorganisms in water was conducted. Based upon the availability of technologies and their configurations, an assessment of the appropriate strategies to pursue for the near and long term development plans in development of the Rapid Field Bacteriology Test Kit was performed. Near term technologies to improve the Army's capability to detect microorganisms would appear to be essentially improvements in versatility and measurement of coliform indicator organisms. New chromogenic and fluorogenic indicator substances associated with new substrates appear to be best suited for test kit development either for quantitative membrane filter tests or presence/absence and multiple fermentation tests. Test times, incubator requirements, and operator involvement appear to be similar to older technologies. Long term development would appear to favor such technologies as genetic probes with amplification of the hydrodized nucleic acid materials of positive samples, and some immunological based systems such as enzyme linked, immuno-sorbent assays. In both cases, the major problems would appear to be sample preparation and development of signal strengths from the reactions which would allow the user to see results in 1 hour. GRA

N92-18102# Michigan Univ., Ann Arbor.
RADIOPHARMACEUTICALS FOR DIAGNOSIS AND TREATMENT
D. E. Kuhl 1991 5 p
(Contract DE-FG02-88ER-60639)
(DE92-004065; DOE/ER-60639/4) Avail: NTIS HC/MF A01

In this grant period, we have continued our efforts in the areas of PE basic radiochemistry, radiopharmaceutical synthesis, and preclinical radiopharmaceutical evaluation. A new synthetic sequence, consisting, of no-carrier-added fluorine-18 labeling of substituted benzaldehydes followed by reductive decarbonylation, has been developed. This new methodology can be applied to the fluorine-18 labeling of a wide variety of drugs not previously accessible through existing fluorine-18 labeling methods. Following up on a literature report that the ability to radiolabel aromatic rings can be predicted by C-13 NMR chemical shifts, we have examined the generality of this correlation in aromatic rings bearing a variety of substituents. Although the original correlation holds for nitro substituted anisaldehydes, it cannot be extended to other rings substitution patterns. We have examined the relationship of in vivo localization of various fluorine-18 labeled dopamine uptake inhibitors to their in vitro binding affinities and lipophilicities. We have found that remarkably small decreases in binding affinity result in dramatic losses of in vivo binding to the desired high affinity binding sites. In order to probe the effects of endogenous neurotransmitter on the in vivo binding of radiolabeled dopamine uptake inhibitors, we have examined the in vivo regional localization of (F-18)GBR 13119 after acute and chronic drug treatments which alter the endogenous levels of dopamine. We have found that acute changes in dopamine levels do not affect the binding of this radioligand, but chronic depletion of neurotransmitter results in down-regulation of the in vivo binding sites. DOE

N92-18296# California Univ., San Diego, La Jolla.
THE MOLECULAR BASIS FOR UV RESPONSE OF CULTURED HUMAN CELLS
M. Karin 1991 4 p
(Contract DE-FG03-86ER-60429)
(DE92-003766; DOE/ER-60429/T1) Avail: NTIS HC/MF A01

During the past year we have analyzed the mechanism by which UV and H2O2 increase the activity of AP-1 in HeLa cells. AP-1 is a dimeric protein complex composed of the fos and jun gene products. After UV irradiation of HeLa cells (or exposure to H2O2), expression of the c-jun gene rapidly increases at least 50-fold. This induction occurs through the previously identified AP-1 site in the c-jun promoter. This positive autoregulation is mediated by AP-1 complexes that are composed mostly of cJun. cJun is a phosphoprotein that undergoes complex changes in its phosphorylation state following exposure to phorbol esters, growth factors or transforming oncogenes. We show that UV irradiation causes increases in the phosphorylation of cJun. We have been trying to determine the common signal by which DNA damaging agents lead to activation of the UV response. We present evidence that oxidative stress may serve as a signal for AP-1 induction during the UV response. We are also trying to purify and characterize UVIC, a factor secreted from UV damaged cells which protects non-irradiated cells from damage. We have identified UVIC as a 17 kDa polypeptide that retains radioprotective activity after SDS-PAGE and renaturation. We are currently scaling up the isolation and purification process. DOE

N92-18339# Oxford Univ. (England). Medical Engineering Unit.
PULSE OXIMETRY: THEORETICAL AND EXPERIMENTAL MODELS
J. P. deKock and L. Tarassenko 26 Jun. 1991 41 p
(OUEL-1885/91; ETN-92-90909) Avail: NTIS HC/MF A03

A model for understanding and quantifying the phenomena underlying pulse oximetry using an approach which combines both theoretical and empirical modeling is developed. The optical

properties of whole blood were measured as a function of pathlength by transmission spectrophotometry using Red (R) (660 nm) and Infrared (IR) (950 nm) light emitting diodes as light sources. Readings were taken from a number of cuvettes of differing depths using diffusers to scatter the light before and after it interacts with the blood film. Twersky's theoretical model for the optical properties of whole blood gives the best fit to the experimental data. A simple theoretical model which takes into account the nonlinear relationship between optical density and pathlength in order to obtain an expression for the R/IR ratio, which relates the measurement of transmission at the two wavelengths, is also used. The R/IR ratio is found to be more or less independent of pathlength. Twersky's theoretical model, together with the simple model for obtaining an expression for the R/IR ratio, is concluded to provide a valid approach to the understanding of the phenomena undergoing pulse oximetry, as shown in the good correlation between the results predicted by the model and earlier, entirely experimental, in vitro experiments. ESA

N92-18419# Oakland Univ., Rochester, MI.
MECHANISMS FOR RADIATION DAMAGE IN DNA
M. D. Sevilla Dec. 1991 17 p
(Contract DE-FG02-86ER-60455)
(DE91-019079; DOE/ER-60455/5) Avail: NTIS HC/MF A03

In this project we have proposed several mechanisms for radiation damage and recently radiation protection to DNA and its constituents, and have detailed a series of experiments utilizing electron spin resonance spectroscopy, HPLC and GC-mass spectroscopy to test the proposed mechanisms. In this years' work we have continued the investigation of the localization of the initial charges on DNA after irradiation through experiment and through the use of ab initio molecular orbital theory. The experimental results and MO calculations are in agreement that cytosine, not thymine, is likely the principal locus for excess charge; whereas guanine is confirmed as the initial site for the cationic charge. The mechanism for the anion localization on cytosine is clarified by MO calculations of DNA base pair and stacked base pair (GC/AT) ion radicals. In addition predictions made from a new model of ion transfer in DNA are tested and confirmed by an ESR investigation of irradiated single stranded DNA. In this years' effort in joint work with Wake Forest University we have also made excellent progress in the study of products produced from the direct effect of radiation on DNA. The release of unaltered bases and DNA base damage products are shown to be a function of hydration layer and evidence for a demarcation between the direct and indirect effect of radiation is presented. DNA base products from irradiations at ambient temperatures are shown to be those that would be predicted from ESR studies at low temperatures. In addition initial studies of radiation effects on DNA-protein complexes and certain sensitive amino acids have been initiated to shed light on the role of histones on DNA radiation damage. DOE

N92-18598# Michigan Univ., Ann Arbor. School of Public Health.
DEVELOPMENT OF A REVISED MATHEMATICAL MODEL OF THE GASTROINTESTINAL TRACT Ph.D. Thesis
A. Barker Jan. 1991 181 p
(Contract DE-AC05-76OR-00033)
(DE92-004748; DOE/OR-00033/T453) Avail: NTIS HC/MF A09

The objectives of this research are as follows. First, to incorporate new biological data into a revised mathematical adult gastrointestinal tract model that includes: ingestion in both liquid and solid forms; consideration of absorption in the stomach, small intestine, ascending colon, transverse colon or not at all; gender and age of the adult; and whether the adult is a smoker or not. Next, to create a computer program in basic language for calculating residence times in each anatomical section of the GI tract for commonly used radionuclides. Also, to compare and contrast the new model with the ICRP 30 GI tract model in terms of physiological concepts, mathematical concepts, and revised residence times for several commonly used radionuclides. Finally, to determine whether the new model is sufficiently better than the current model to warrant its use as a replacement for the Eve model. DOE

N92-18799# Westinghouse Hanford Co., Richland, WA.
BENEFICIAL USES OF RADIATION
M. R. Fox Oct. 1991 13 p
(Contract DE-AC06-87RL-10930)
(DE92-003024; WHC-SA-1273) Avail: NTIS HC/MF A03

An overall decline in technical literacy within the American public has come at a time when technological advances are accelerating in the United States and around the world. This has led to a large communication gulf between the general public and the technologists. Nowhere is this more evident than with the topic of radiation. Regrettably, too few people know about the pervasiveness, amounts, and variabilities of sources of radiation. Nor do many people know that radiation has been used in beneficial ways for decades around the world. While the general public does not know of the scientific applications in which radiation has been employed, it has benefitted from these efforts. Thanks to the well know properties of radiation, scientific ingenuity has found many uses of radiation in chemical and agricultural research, biomedical research, in the diagnoses and treatment of hundreds of types of diseases, in industrial applications, food irradiation, and many other areas. This paper provides a sample of the types of applications in which radiation has been used to advance humankind. DOE

N92-18859# Central Inst. for the Deaf, Saint Louis, MO.
BINAURAL MASKING: AN ANALYSIS OF MODELS Final Technical Report, 1 Apr. 1989 - 31 Jan. 1991
Robert H. Gilkey 21 Nov. 1991 29 p
(Grant AF-AFOSR-0302-89; AF Proj. 2313)
(AD-A244392; AFOSR-91-1022TR) Avail: NTIS HC/MF A03
CSCL 06/3

The goal of this program of research has been to specify auditory processing in the presence of noisy backgrounds. A variety of experimental and modeling approaches have been employed to examine this processing. Overall the results suggest the importance of spectral and temporal comparisons in signal detection and suggest that similar processing underlies monaural and binaural detection. The introduction of masker energy in temporal intervals that did not overlap with the signal could be shown to either enhance or degrade detection performance, depending on the interaural parameters of the stimuli. Experiments on remote masking and suppression showed excitatory and inhibitory effects that extended across more than an octave. These results are being used to evaluate a nonlinear model of cochlear processing. The responses of subjects to individual stimuli (reproducible noise samples) were highly correlated between monaural and binaural conditions that had seemed dramatically different when the ensemble performance was considered (i.e., data averaged across noise samples). GRA

N92-18972# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
HIGH ALTITUDE AND HIGH ACCELERATION PROTECTION FOR MILITARY AIRCREW
Oct. 1991 264 p In ENGLISH and FRENCH Symposium held in Pensacola, FL, 29-30 Apr. 1991
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These proceedings include the technical evaluation report, the keynote address, and the 28 papers of the symposium. The papers addressed a variety of topics including (1) decompression sickness and ebullism at high altitude; (2) effects of high acceleration in terms of G-induced loss of consciousness (GLOC), positive pressure breathing (PBG), the anti-G straining maneuver (AGSM), and neck injury protection; (3) modeling effects of high acceleration on the cardiovascular system; (4) very high altitude protection; and (5) integrative protection equipment to high altitude, high

acceleration, and other harmful stressors. For individual titles, see N92-18973 through N92-19000.

N92-18973# Air Force Systems Command, Brooks AFB, TX. Armstrong Lab.
DECOMPRESSION SICKNESS AND EBULLISM AT HIGH ALTITUDES
Andrew A. Pilmanis and Barbara J. Stegmann (Krug Life Sciences, Inc., San Antonio, TX.) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 11 p (For primary document see N92-18972 09-52)
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The use of high altitude air space for military activities exposes flight crews to the hazards of near vacuum ambient pressures. Both the U.S. Advanced Tactical Fighter and the National Aerospace Plane will travel at heights where unprotected exposure to the environment leads to severe physiological consequences, including decompression sickness (DCS) and ebullism. Information about DCS occurring at or above altitudes of 40,000 feet is minimal. Theoretically, bubble growth will be rapid and latency of symptoms short. The ultimate DCS consequences of such high exposures, even very short ones, may be influenced by the pre- and post-events of a rapid decompression (RD), including prebreathing, and post-exposure medical intervention. Ebullism, or the vaporization of body fluids, poses additional physiological risks to flight above 63,000 feet. Medical treatment protocols for ebullism in the event of accidental manned exposures to extreme altitudes do not exist. As research, training, and operational flights of new measures and treatment protocols becomes essential. Author

N92-18974# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
BUBBLE NUCLEATION THRESHOLD IN DECOMPLEMENTED PLASMA **c51**
C. A. Ward, D. Yee, D. McCullough, and W. D. Fraser (Defence and Civil Inst. of Environmental Medicine, North York, Ontario) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p Sponsored in part by Defence and Civil Inst. of Environmental Medicine, North York, Ontario (For primary document see N92-18972 09-52)
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Previous work has indicated that rabbits that are more susceptible to decompression sickness (DCS) are also more sensitive to complement activation by air bubbles, and that rabbits can be protected from DCS if they are pharmacologically decomplemented before they are subjected to the pressure profile. We have investigated a possible means by which decomplementing a rabbit could protect it from DCS. Since DCS is thought to be produced by bubbles that are formed in the tissues of an animal because of its tissues becoming oversaturated with dissolved gas as the animal undergoes a pressure profile, we have investigated the possibility that decomplementing an animal protects it from DCS by making it more difficult to form bubbles in one of the tissues of primary concern, blood plasma. This investigation was performed with three test liquids: (1) water; (2) native rabbit plasma; and (3) decomplemented plasma. We find that the threshold for bubble nucleation in water is greater than that in either plasma or decomplemented plasma, but we do not find any difference between the nucleation threshold of the two types of plasma. Thus, the indications are that the protection from DCS that results from decomplementing a rabbit does not appear to develop because of a change in the nucleation threshold of the decomplemented plasma. Author

N92-18975# Air Force Systems Command, Brooks AFB, TX. High Altitude Protection Function.
THE 1990 HYPOBARIC DECOMPRESSION SICKNESS WORKSHOP: SUMMARY AND CONCLUSIONS
Andrew A. Pilmanis, ed. *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p Workshop held at Brooks AFB, TX, Oct. 1990 (For primary document see N92-18972 09-52)
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Decompression sickness resulting from exposure to the hypobaric environment was reviewed and discussed at a three-day workshop hosted by the U.S. Air Force in Oct. 1990. This milestone meeting updated the current understanding of this condition. Gaps in this understanding were identified based on input from both research and operational participants. The results of this workshop are summarized. Author

N92-18976# Krug Life Sciences, Inc., San Antonio, TX.
PREBREATHING AS A MEANS TO DECREASE THE INCIDENCE OF DECOMPRESSION SICKNESS AT ALTITUDE
Barbara J. Stegmann and Andrew A. Pilmanis (Air Force Systems Command, Brooks AFB, TX.) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 8 p (For primary document see N92-18972 09-52)
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Prebreathing with 100 percent oxygen for protection against serious decompression sickness (DCS) is standard practice in the U.S. Air Force (USAF). Before prebreathing became routine, there were 18 reported deaths directly related to altitude DCS. Since prebreathing has become instituted, only one death has bean reported. However, DCS cases still occur and are primarily associated with training in altitude chambers. At the Armstrong Laboratory (AL), Brooks Air Force Base, Texas, research on the use of prebreathing to enhance denitrogenation is directed at optimizing schedules for current operational requirements in both aviation and space. Concurrently, development of a decompression/denitrogenation computer is also underway. This analytical model is based on both laboratory and operational data bases, and will have both real-time and predictive capability. However, the accuracy of these data bases is in question. DCE reporting problems, inconsistencies in medical diagnosis, arbitrary classification of symptoms, historical variation in symptom definition, and the subjectiveness of intravascular bubble detection techniques must be taken into account before reasonable reliability can be applied to this model. Author

N92-18977# Air Force Systems Command, Brooks AFB, TX. Armstrong Lab.
G-INDUCED LOSS OF CONSCIOUSNESS ACCIDENTS: USAF EXPERIENCE 1982-1990
Terence J. Lyons, Richard Harding, James Freeman, and Carolyn Oakley *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 9 p Previously announced in IAA as A92-20719 Prepared in cooperation with Air Force Inspection and Safety Center, Norton AFB, CA (For primary document see N92-18972 09-52)
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A review of the 18 accidents attributable to loss of consciousness induced by high-G flight (G-LOC) is conducted to discuss potential acceleration-protection measures. The data show that all accidents are found to have significantly higher systolic blood pressure and fewer aircraft-specific flying hours than other pilots. The pilots seem to represent a typical cross section of the pilot pool in terms of personal variables. It is suggested that the most important variables contributing to the accidents are G duration, G magnitude, the use of G trousers, and experience with the aircraft in question. Author

N92-18978# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
PULMONARY EFFECTS OF HIGH-G AND POSITIVE PRESSURE BREATHING
David H. Glaister *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p (For primary document see N92-18972 09-52)
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Since positive pressure breathing (PPB) can provoke syncope even at low gravity, its use to support the circulation and prevent G-induced loss of consciousness (G-LOC) appears somewhat of a paradox. Furthermore, when right heart pressures are normally only a few mm Hg, an alveolar pressure of 65 mmHg produced by PPB appears alarming, and concern has been expressed as to the advisability of enhancing G protection. The effects of acceleration and pressure breathing on the circulation, particularly within the lungs, are examined, and it is concluded that when one considers pressure differentials across the walls of the major vessels and heart chambers, these concerns are largely unjustified. Author

N92-18979# Defence and Civil Inst. of Environmental Medicine, North York (Ontario).

MAXIMUM INTRA-THORACIC PRESSURE WITH PBG AND AGSM

F. Buick, J. Hartley, and M. Pecaric *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 9 p (For primary document see N92-18972 09-52)
(DCIEM-91-43) Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Positive pressure breathing during +Gz (PBG) and anti-G straining maneuvers (AGSM) each improve +Gz tolerance by increasing blood pressure through increases in intra-thoracic pressure, but the maximal intra-thoracic pressure from their combined effect is not known. Six subjects performed: (1) maximal AGSM at +1Gz; (2) assisted PBG (constant 60 mm Hg) at +Gz; (3) submaximal AGSM at +Gz (enough to maintain peripheral vision); (4) maximal AGSM at +Gz; and (5) combined PBG and maximal AGSM at +Gz. They wore: Tactical Life Support System (TLSS) mask/helmet ensemble, CSU-15/P G-suit, and TLSS-style jerkin. Intra-thoracic pressure (Pes) was measured with a catheter tip pressure transducer in the esophagus. Gastric pressure (Pga) was also measured. For both Pes and Pga, there were no significant differences among experimental conditions (1), (4) and (5). Group mean Pes and Pga in these 3 conditions were 139 and 197 mm Hg, respectively. The similar results between maximal AGSM, and maximal AGSM and PBG are explained by: (1) limited support from the thoracic counter-pressure garment, and (2) the characteristics of the respiratory system. Author

N92-18980# Air Force Systems Command, Brooks AFB, TX. Crew Systems Directorate.

THE INFLUENCE OF HIGH, SUSTAINED ACCELERATION STRESS ON ELECTROMYOGRAPHIC ACTIVITY OF THE TRUNK AND LEG MUSCLES

Larry P. Krock and Mark W. Cornwall *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p Prepared in cooperation with Arizona State Univ., Flagstaff (For primary document see N92-18972 09-52)
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This study investigated the level and pattern of trunk and lower extremity muscle activity in aircrew performing the anti-G straining maneuver (AGSM) at high, sustained +Gz. Ten male, trained centrifuge riders experienced rapid onset profiles (4G/s) to +6 Gz , and sustained this level on the Armstrong Laboratory's Human Centrifuge until greyout. Surface electromyography (EMG) was recorded from the erector spinae, lateral abdominal, biceps femoris, vastus lateralis, and lateral gastrocnemius muscles of the subject's dominant side. The normalized root mean square (RMS) and mean power frequency (MPF) were calculated for each muscle at 1-second intervals throughout the exposure. The RMS amplitude for the muscles of the lower extremity showed a marked decrease (-61.45 percent) while muscles of the trunk exhibited a slight increase (+3.45 percent). The MPF of the EMG signal did not demonstrate a significant change during the exposure. Motor unit recruitment decreased in the lower extremity muscles during exposure. None of the studied muscles demonstrated a shift in the MPF suggesting evidence of fatigue. The results of the present study suggest the importance of maintaining a high level of muscle activity in the legs throughout exposure to sustained high levels of acceleration stress that require use of the AGSM. Author

N92-18981# Royal Netherlands Air Force, Soesterberg. Dept. of Aviation Medicine.

THE VALSALVA MANEUVER AND ITS LIMITED VALUE IN PREDICTING +Gz-TOLERANCE

E. J. vanLieshout, J. J. vanLieshout, J. Krol, M. Simons, and J. M. Karemaker (Amsterdam Univ., Netherlands) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p (For primary document see N92-18972 09-52)
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The aim of the present study was to investigate, in healthy subjects, if responses to a cardiovascular reflex test, the Valsalva maneuver (VM), might be predictive for +Gz-tolerance. The main finding is a significant correlation between blood pressure recovery during VM and peripheral light loss (relaxed, before executing the M1/L1-manuever) ($r = 0.63$, p less than 0.05). All other parameters, including baroreflex sensitivity, did not significantly correlate with +Gz-tolerance. Furthermore intact baroreflex pathways were determined in all subjects. These results indicate that the parameters derived from the cardiovascular responses to VM may only confirm baroreflex integrity. Therefore VM might be used in the diagnostic process for fighter pilots with repeated +Gz-loss of consciousness inflight who are suspected of an orthostatic disorder. However in a healthy subject VM has limited value in predicting +Gz-tolerance. Author

N92-18982# Air Force Systems Command, Brooks AFB, TX. Crew Technology Div.

HEMODYNAMIC RESPONSES TO PRESSURE BREATHING DURING +Gz (PBG) IN SWINE **c51**

J. W. Burns, J. W. Fanton, and J. L. Desmond *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)
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Twelve chronically instrumented, unanesthetized, miniature swine were used to investigate the hemodynamic interrelationships of positive pressure breathing at G (PBG), the anti-G straining maneuver (AGSM), and the G-suit, during gradual onset rate (GOR) and simulated aerial combat maneuver (SACM) +Gz profiles. Maximum left ventricular pressure (LVP) and aortic pressure (AP) of over 300 mmHg, and left ventricular end-diastolic pressure (LVEDP) and right ventricular end-diastolic pressure (RVEDP) of over 160 mmHg and 100 mmHg, respectively, were common during the GOR and SACM exposures at 9 +Gz using an extended coverage G-suit (ECGS). A concurrent, substantial increase in intrathoracic pressure attenuated transmural vascular pressures within the thorax. The performance of the ECGS was significantly better than the abdominal bladder G-suit (ABGS), with or without PBG. A PBG effect could not be demonstrated while using the ECGS, during either the GOR or SACM profiles. Author

N92-18983# Air Force Systems Command, Brooks AFB, TX. Human Systems Div.

SUBJECTIVE REPORTS CONCERNING ASSISTED POSITIVE PRESSURE BREATHING UNDER HIGH SUSTAINED ACCELERATION

Kathy McCloskey, Lloyd D. Tripp, Daniel W. Repperger, and Stephen E. Popper *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 6 p (For primary document see N92-18972 09-52)
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Assisted positive pressure breathing, as found in the Combined Advanced Technology Enhanced Design G Ensemble (COMBAT EDGE) system, was shown to have distinct advantages and disadvantages concerning the subjective opinion of the system under sustained acceleration. Advantages include subjects' perceptions of the system as an advancement in G-protection

technology, personal projections of increased tolerance to G-forces, decreases in fatigue due to a lessening of straining maneuver effort, and an increase in breathing ease during acceleration, at least for subjects with COMBAT EDGE experience. Disadvantages include an increased incidence of arm pain, breathing difficulties for subjects new to the system, and a tendency to rely too much on the system in lieu of traditional straining maneuvers. It is recommended that a training regimen be established to address these issues before the COMBAT EDGE system is deployed operationally. Author

N92-18984# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge (France). Div. de Biomecanique.
G-LOC. Gz AND BRAIN HYPOXIA. Gz/s AND INTRACRANIAL HYPERTENSION
P. Quandieu, D. Gaffie, Ph. Liebaert, M. Briane, J. C. Sarron (Direction des Recherches, Etudes et Techniques, Paris, France), A. Guillaume, D. Tran, and J. Ph. Haymann *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 15 p Sponsored in part by DRET G9 (For primary document see N92-18972 09-52)
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The tilt of aircraft during a slow steep turn subjects the pilot to an acceleration which is colinear to the longitudinal axis of the body and can reach several times the acceleration of earth gravity. The purpose of this study is to propose a strictly biomechanic explanation of sudden inflight Loss Of Consciousness (LOC), i.e., brain nerve structures subject to Rapid Onset Rate (ROR) +Gz become functionally inefficient, not because of a shortage of oxygen, but because a sudden rise in brain mechanical stresses causes sudden intercranial hypertension. A simple model is proposed to analyze the following parameters: pressure distribution in the Cerebro-Spinal Fluid (CSF); distribution of stresses and deformations throughout the brain; and changes in blood flow pulsed into the skull. Calculations show the influence of a sudden change in flow rate causing collapses and supercritical flows sometimes followed by intravascular shocks. The first results of this modeling study indicate that ROR +Gz acceleration could augment mechanical stresses inside nerve tissues, and therefore result in sudden intracranial hypertension. Author

N92-18985# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.
ASSISTED POSITIVE PRESSURE BREATHING: EFFECTS ON +Gz HUMAN TOLERANCE IN CENTRIFUGE
J. M. Clere and J. W. Burns (Air Force Systems Command, Brooks AFB, TX.) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 8 p In FRENCH and ENGLISH (For primary document see N92-18972 09-52)
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The goal of this paper is to present an experiment on the effect of Assisted Positive Pressure Breathing (APPB) as a method of increasing G-time tolerance and improving very rapid onset rate (VROR) tolerance using APPB equipment. Six male volunteers were tested on a USAF centrifuge. The equipment used was a helmet with an occipital bladder for automatic mask tightening, mask, jerkin and G-suit, breathing regulator, and high flow G-valve. A standard ejection seat was used, positioned at 30 deg. Acceleration profiles were 9 +Gz for 10 sec at 1 G s(exp -1) or 4 G s(exp -1) and a 5-9 +Gz Simulated Aerial Combat Manoeuvre (SACM) profile at 4 G s(exp -1), with and without APPB. The anti-G straining maneuver (AGSM) was used as necessary to maintain adequate vision. APPB was a maximum of 9 kPa (68 mmHg) at 9 +Gz. Heart rate was calculated and heart rhythm anomalies were detected by an EKG. APPB had no significant effect on VROR tolerance or heart rate. APPB statistically increased G-time tolerance (167.9 +/- 38.4 s with APPB and 88.4 +/- 23.1 s without APPB (p less than 0.001)). Author

N92-18986# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
THE OPTIMISATION OF A POSITIVE PRESSURE BREATHING SYSTEM FOR ENHANCED G PROTECTION
A. R. J. Prior *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 11 p (For primary document see N92-18972 09-52)
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An electronic, computer controlled system was developed that allows full control of mask pressure and anti-G trouser inflation pressure in a pressure breathing anti-G system (PBG) installed on a human centrifuge. The apparatus was used to study the effect of different mask and trouser inflation pressures upon G protection in four subjects exposed to +Gz acceleration in the range 3 to 7 G while wearing full coverage anti-G trousers and a chest counter pressure waistcoat. Eye level arterial blood pressure was used as an objective measurement of G protection while subjective assessment of peripheral vision, anti-G trouser inflation pressure, mask pressure, and arm discomfort was measured using a ten centimeter line technique. The results show that eye level arterial blood pressure is better maintained as both mask and trouser inflation pressure are increased, however, peripheral vision was degraded to only 34 pct. of normal under any of the experimental circumstances. Subjectively, the preferred schedule of inflation for the anti-G trousers was 1.3 psi/G with a cut-in of about 2 Gz; for the PBG mask pressure it was 14 mmHg/G with a 3 Gz cut-in point. Arm pain occurred in all subjects and may be related to venous pressure. Author

N92-18987# Air Force Systems Command, Brooks AFB, TX. Crew Technology Div.
EFFECTS ON Gz ENDURANCE/TOLERANCE OF REDUCED PRESSURE SCHEDULES USING THE ADVANCED TECHNOLOGY ANTI-G SUITE (ATAGS)
L. J. Meeker *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p (For primary document see N92-18972 09-52)
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An advanced lower body full coverage anti-G suit was developed and is called the Advanced Technology Anti-G Suit (ATAGS). Previous centrifuge studies using standard pressurization schedules, flight tests, and theoretical considerations suggest that the ATAGS might provide equivalent G protection using reduced pressures. This study was conducted to determine the G protection afforded by ATAGS using a lower pressure schedule. Six test subjects were exposed to three separate G profiles during three test sessions. The profiles were: a gradual onset with the subject relaxed; a rapid onset to 9 G for 10 seconds with the subject performing an anti-G straining maneuver (AGSM); and a rapid onset 5 to 9 G Simulated Aerial Combat Maneuver (SACM) with 10 sec at each level, repeated to exhaustion. A different anti-G suit pressurization schedule was used at each test session. Data were analyzed by making statistical comparisons of performance between different pressure profiles, both for tolerance and endurance. Results suggest that the present standard of 10 to 8 psig at 9 G without reducing G protection, but that a pressure schedule resulting in 6 psig at 9 G is insufficient. Author

N92-18988# British Aerospace Aircraft Group, Kingston-upon-Thames (England).
THE MILITARY AIRCREW HEAD SUPPORT SYSTEM (MAHSS) **c54**
A. A. Marshall *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)
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The Military Aircrew Head Support System (MAHSS) is designed to give the pilot extra support to his head and torso by means of cables under the control of a microprocessor. This calculates the expected tension on the cables under the prevailing G forces. It

then compares these values with the actual strain on the cables. Any differences in tension to those calculated should be as a result of the pilot trying to move, and the cables will be adjusted to assist him. The MAHSS should offer benefits in terms of less fatigue (biology) and injury and the ability of the pilot to move his head while maneuvering without the danger of getting stuck in a slumped position during high G. It could also be useful during the ejection sequence, by reeling in the cables and this stabilizing the pilot's body and spine in the line of the ejection force. A simplified system was tested to 6 G in a human centrifuge with manual control of the cable lengths. The development of the system is described, including biomechanical modeling and a study into its acceptability to pilots, and other human factors issues. Author

N92-18989# Drexel Univ., Philadelphia, PA.
A CARDIOVASCULAR MODEL OF G-STRESS EFFECTS: PRELIMINARY STUDIES WITH POSITIVE PRESSURE BREATHING
Dov Jaron, Thomas W. Moore, and Pierre Vieyres *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 7 p (For primary document see N92-18972 09-52)
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To study possible means of ameliorating the effects of gravitational acceleration on the cardiovascular system, a nonlinear digital computer model was developed. It combines a variable compliance model of the left ventricle, multielement models of the aorta and the systemic and venous systems, and lumped models of peripherial vascular beds. The vascular elements are obtained from the solution of the Navier-Stokes equations, combined with a set of simplifying assumptions. This closed loop system includes heart rate control and venous tone control, and the effects of acceleration forces. The model also can simulate the effect of several modes of G protection, including the anti-G suit, straining maneuvers, positive pressure breathing (PPB), and seat back angle. In this study, this model was used to gain an understanding of the effects of positive pressure breathing on G tolerance and to compare these effects to other protection methods. Author

N92-18990# Biodynamics International, Halifax (Nova Scotia).
ASSESSMENT OF PHYSIOLOGICAL REQUIREMENTS FOR PROTECTION OF THE HUMAN CARDIOVASCULAR SYSTEM AGAINST HIGH SUSTAINED GRAVITATIONAL STRESSES
Richard Collins and Emilia Mateeva *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 12 p (For primary document see N92-18972 09-52)
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Satisfactory performance of combat pilots exposed to rapid onset of high sustained gravitational stress (+G) is compromized by caudalward fluid shifts which provoke 'compensatory' responses from the central nervous system. Such neural, metabolic, and humoral responses can lead to dramatic alterations in the heart rate, stroke volume, cardiac output, myocardial contractility, and vascular tonus, with the clear danger of loss of vision, loss of consciousness, and myocardial fibrillation and ischemia. A simple but complete model of the coronary circulation is proposed as a framework for organizing a systematic research program for the passive and active control of this circulation under conditions of extreme g-stress. Within such a framework, preliminary conclusions can be drawn concerning the study of effective countermeasures designed to enhance pilot tolerance in air-combat maneuvers. Author

N92-18991# Office National d'Etudes et de Recherches Aerospatiales, Paris (France). Direction de l'Energetique.
CIRCULATORY BIOMECHANICS EFFECTS OF ACCELERATIONS
D. Gaffie, P. Quandieu, Ph. Liebaert, D. Cohen-Zardy, T. Daumas, and A. Guillaume (Centre d'Etudes et de Recherches de Medecine Aerospatiale, Bretigny sur Orge, France) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 15 p Original language document was announced in IAA as A91-45645 Sponsored in part by DRET (For primary document see N92-18972 09-52)
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A general physical model of blood flow behavior in vessels is proposed, to have a better understanding of mechanisms which cause inflight loss of consciousness (LOC) in fighter pilots. The problem in the situation when heart work and external disturbances induced by aircraft motions are concomitant. Disturbances are both volume and surface changes. Calculations show that under certain conditions blood flow is limited to a change in flow rate. It can then be hypothesized that under the effect of a sudden load, LOC could be caused by a factor other than brain hypoxia resulting from blood pooling in the pilot's lower limbs. Author

N92-18992# Victoria Univ. (British Columbia). Dept. of Mechanical Engineering.
FINITE ELEMENT MODELING OF SUSTAINED +Gz ACCELERATION INDUCED STRESSES IN THE HUMAN VENTRICLE MYOCARDIUM
J. Moore, B. Tabarrok, and W. Fraser (Defence and Civil Inst. of Environmental Medicine, Downsview, Ontario) *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 7 p (For primary document see N92-18972 09-52)
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Due to reports of endocardial hemorrhaging and myofibrillar degradation in swines undergoing high sustained +Gz accelerations, questions arise as to the possibility of cardiac tissue damage in humans subjected to similar Gz forces. Noninvasive cardiological techniques used during experiments seem too insensitive to provide data to determine the presence of any localized cardiac damage. In addition, these tests involve some risk to the subject. Hence, there exists the need for a model to predict possible tissue damage under high sustained +Gz accelerations. The development is presented of such a model for the analysis of +Gz induced stresses in the human ventricle myocardium. The model is based on the finite element method where the effects of finite displacements, large strains and nonlinear nearly incompressible materials behavior are accounted for. When experiments cannot be justified, the computational model can provide valuable quantitative (gross distortions and predicted stresses) data on the effects of +Gz induced stresses in humans. Ultimately, the goal is to provide some form of cardiac risk assessment for pilots of high performance aircraft. Author

N92-18993# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
PHYSIOLOGICAL REQUIREMENTS FOR PARTIAL PRESSURE ASSEMBLIES FOR ALTITUDE PROTECTION **c54**
A. J. F. Macmillan *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 7 p (For primary document see N92-18972 09-52)
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Partial pressure assemblies using an oronasal mask and garments providing counter pressure to the torso and lower limbs may be used to provide protection against a short term exposure (1 to 2 minutes) to altitudes up to 60,000 to 65,000 feet. The performance characteristics of the delivery system used in such emergency exposures must be at least as good as that required during routine operations. Mask cavity pressure of up to 80 mmHg may be tolerated for a short period, provided adequate chest and lower limb counter pressure is provided. When upper body counter pressure is limited to the chest, then anti-G suit pressure should be at least 3 times the breathing pressure. Further tradeoffs of breathing pressure and counter pressure against absolute oxygen pressure with the use of gas mixtures with less than 100 percent oxygen should be defined by examining the effect of these tradeoffs on performance, arterial gas tensions and cardiovascular responses. Author

N92-18994# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.
FRENCH EQUIPMENT FOR INTEGRATED PROTECTION OF COMBAT AIRCRAFT CREWS: PRINCIPLES AND TESTS AT HIGH ALTITUDES [L'EQUIPEMENT FRANCAIS DE PROTECTION INTEGREE POUR EQUIPAGES D'AVIONS DE COMBAT MODERNE: PRINCIPES ET ESSAIS EN HAUTE ALTITUDE] **c54**
Henri Marotte, Henri Vieillefond (Service de Sante des Armees, Paris, France), Damien Lejeune, and Jean-Michel Clere *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 11 p In FRENCH; ENGLISH summary (For primary document see N92-18972 09-52)
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Personal flight equipment, manufactured and tested in France, to be used to protect aircraft crews against the risk of loss of pressurization at high altitudes is discussed. Slow decompression tests up to 60,000 feet showed that the altimetric positive pressure schedule was badly adapted for this kind of equipment. Specific schedules for altimetric dilution and positive pressure were established and tested with a series of rapid decompression experiments (in 2 seconds). Some explosive decompression tests were also performed. The homologation was obtained for the maximum altitude of 65,000 feet, maximum duration above 40,000 feet of 2 to 3 minutes, and an aircraft pressurization schedule of 35 kPa. Author

N92-18995# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
THE EXPERIMENTAL ASSESSMENT OF NEW PARTIAL PRESSURE ASSEMBLIES **c54**
D. P. Gradwell *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)
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A new generation of partial pressure assemblies were assessed with particular reference to the optimization of counter-pressure relationships. A system of non-invasive assessment of the physiological consequences of using such assemblies during pressure breathing and following rapid decompression to altitudes between 45,000 and 60,000 feet were developed. The methods used are described and an outline of the results achievable with this system are discussed. The physiological benefits of enhanced lower body counter-pressure compared with uniform levels of pressure garment inflation are described. Suggestions for further research are given. Author

N92-18996# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.
PHYSIOLOGICAL PROTECTION EQUIPMENT FOR COMBAT AIRCRAFT: INTEGRATION OF FUNCTIONS, PRINCIPAL TECHNOLOGIES [PROTECTION PHYSIOLOGIQUE DES EQUIPAGES D'AVIONS DE COMBAT: INTEGRATION DE FONCTIONS, PRINCIPES TECHNOLOGIQUES] **c54**
Henri Marotte, Raymond Beaussant, Richard Zapata (L'Air Liquide, Sassenage, France), Jean-Michel Clere, and Damien Lejeune *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 8 p In FRENCH; ENGLISH summary (For primary document see N92-18972 09-52)
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New generation combat aircraft crews are submitted to many kinds of constraints during flight. New technologies were developed, such as the molecular sieve oxygen concentrator (MSOC) or the electronic technology for command and/or control of regulation systems. The equipment developed allows a survey of data from the unlimited oxygen supply, with low pressure oxygen regulation systems, to anti-G protection, thanks to the assisted positive pressure breathing (APPB) apparatus. These systems are orderly integrated into the same multiple equipment systems with both respiratory and anti-G functions. New perspectives were developed: altimetric dilution schedules usable with a partial pressure suit; compatibility of the flight equipment with non-integrated functions; and thermal (cold) protection in case of accidental immersion or nonbattle casualty (NBC) protection equipment. Author

N92-18997# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
MODEL OF AIR FLOW IN A MULTI-BLADDER PHYSIOLOGICAL PROTECTION SYSTEM **c54**
P. S. E. Farrell, D. F. James, and A. A. Goldenberg *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)
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New physiological protection systems are needed in order to keep the pilot in control of the aircraft during high G and high altitude maneuvers. A model was developed for air flow in a multi-bladder physiological protection system. Each bladder of the protection system is modeled as a flexible pressure vessel. The governing equations are derived for fluid flow from one vessel to another. The equations are simplified by five assumptions which are based on the fluid being compressible and inviscid. The result is a set of nonlinear differential equations which describe the isentropic pressure variation within the vessels. The equations are integrated numerically and yield the thermodynamic quantities within each vessel as a function of time. Based on the differential equations, a computer simulation of the flexible pressure vessel model was performed. The simulation allows for many possible configurations and scenarios. Five basic configurations are discussed here. Author

N92-18998# Royal Aircraft Establishment, Farnborough (England). Aircrew Integration Section.
THE DESIGN AND DEVELOPMENT OF A FULL-COVER PARTIAL PRESSURE ASSEMBLY FOR PROTECTION AGAINST HIGH ALTITUDE AND G **c54**
A. E. Hay and Judy E. Aplin *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 6 p (For primary document see N92-18972 09-52)
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A partial pressure assembly comprising a chest counter pressure garment (CCPG) and full-cover trousers (FAGTS) were designed and constructed. The CCPG is a simple two-layer outer garment located under the life preserver and supplied with breathing gas from the demand regulator. The FAGTS comprise a single bladder which covers the abdomen, legs, and feet, retained by an outer inextendable layer of Nomex, with the ability to be donned quickly by employing zips and low friction lacing for final fit adjustment. Gas supplied from a suitably programmed G-valve inflates the garment to provide protection. Details of the design approach and the developmental stages to date are given together with an outline of the anthropometric considerations required to provide a snug fitting assembly from a limited size roll. Author

N92-18999# Normalair-Garrett Ltd., Yeovil (England). Military Breathing Systems.
ADVANCES IN THE DESIGN OF MILITARY AIRCREW BREATHING SYSTEMS WITH RESPECT TO HIGH ALTITUDE AND HIGH ACCELERATION CONDITIONS **c54**
Nigel P. J. Lovett *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p (For primary document see N92-18972 09-52)
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It was concluded that for future aircraft systems the combining of an anti-gravity valve and a breathing regulator into one unit provides the most compact and effective system. The advances made by the research establishments in the development of new aircrew garments reduces the need for quick response, electronically controlled valves, thus suggesting that mechanically controlled systems still provide the optimum protection for aircrews under high acceleration conditions. Author

N92-19000# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
HIGH ALTITUDE HIGH ACCELERATION AND NBC WARFARE PROTECTIVE SYSTEM FOR ADVANCED FIGHTER AIRCRAFT: DESIGN CONSIDERATIONS **c54**
A. J. F. Macmillan *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 7 p (For primary document see N92-18972 09-52)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The physiological, technical and flight safety aspects of the design of an integrated system providing protection against high sustained acceleration, short duration exposure to high altitude and nuclear-biological-chemical (NBC) warfare agents are discussed. The proposed system employs a molecular sieve oxygen concentrator and seat mounted demand regulator and anti-gravity valve together with a source of clean filtered air and an emergency gaseous oxygen supply. The personal equipment assembly comprises counter pressure garments worn external to the NBC protective layer and a man-mounted filter. The filter assembly is used on the ground with a portable ventilator, in the air connected to the breathing gas supply, and post escape as part of a lung powered respirator system. Author

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

N92-18245# North Carolina Univ., Chapel Hill. Dept. of Computer Science.
AUTOMATED PROTOCOL ANALYSIS: TOOLS AND METHODOLOGY
John B. Smith, Dana K. Smith, and Eileen Kupstas Aug. 1991 28 p
(Contract N00014-86-K-0680; NSF IRI-85-19517; NSF IRI-88-17305)
(AD-A242040; TR91-034) Avail: NTIS HC/MF A03 CSCL 23/2

The TextLab Research Group, over the past seven years, has developed a collection of tools and techniques for recording users' interactions with computer systems in machine-readable form and for automatically analyzing and displaying those data. This report catalogs those tools and discusses their methodological context and implications. Tools discussed include the following: tracking users behaviors and producing a machine recorded protocol at the level of action - data an order of magnitude larger than keystrokes; replaying users' sessions from protocol data; modeling users' strategies using formal cognitive grammars; analyzing user sessions by parsing them with the grammars; and displaying results in visual form, both static and animated, to facilitate interpretation and understanding by researchers. These tools are placed in a methodological context by reviewing issues associated with concurrent think-aloud, keystroke, and video protocols; and other computer systems are reviewed that support these forms of protocol data. The discussion concludes by noting the increased importance of data management required by automated methods and our thoughts for a comprehensive environment, built around a protocol management facility, that would integrate the tools discussed and support development of new ones. GRA

54 MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing.

For related information see also *16 Space Transportation.*

N92-18009# Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA.
COMPUTER SIMULATION MODEL OF COCKPIT CREW COORDINATION: A CREW-LEVEL ERROR MODEL FOR THE US ARMY'S BLACKHAWK HELICOPTER
William E. Griffith and John E. Stewart, II Sep. 1991 69 p
(AD-A243618; ARI-RR-1601) Avail: NTIS HC/MF A04 CSCL 23/2

The purpose of this research effort was to build a crew performance computer model, using Micro Saint, a modeling framework which has been used extensively to model workload. The current model should be able to predict crew navigation and obstacle clearance errors as a function of crew workload and a variety of other variables not directly tied to workload (e.g., crew experience and familiarity, and mission threat environment). The UH-60 Blackhawk helicopter was chosen because it is a complex two-pilot aircraft. Terrain flight navigation was selected as the mission because of workload demands and the necessity that crew members communicate and coordinate with one another. This report details the conceptual development of the model and presents preliminary results from parametric experiments that were performed to validate it. Comparisons are made of workload and error probabilities for two variants of the Blackhawk: the UH-60 utility aircraft, and the MH-60K, a special operations variant soon to enter production. GRA

N92-18051# Aeronautical Research Labs., Melbourne (Australia).
AIRCREW TASKS AND COGNITIVE COMPLEXITY
J. G. Manton and P. K. Hughes Nov. 1991 27 p Presented at the Silver Jubilee Conference of the Astralian Psychological Society, Melbourne, Australia, 23-28 Sep. 1990
(ARL-SYS-TM-150; AR-006-650) Copyright Avail: NTIS HC/MF A03

There is an increasing demand for human factors engineering of aircrew tasks during the design and development of future aircraft cockpits and aircrew workstations. The extensive data base of experimental research literature on human performance is of marginal value in aiding the design process. Outlined here are several techniques associated with the analysis and description of aircrew activities for use in prospective studies of aircrew task design. The techniques of protocol analysis, eye movement monitoring, and task analysis, among others, are reviewed. The underlying issue of cognitive complexity in the management of aircrew interfaces is addressed. Author

N92-18080# Naval Postgraduate School, Monterey, CA.
A MANAGEMENT PROPOSAL FOR DETERMINING THE EFFECTS OF COMBAT STRESS ON THE MAN-MACHINE INTERFACE OF COMPLEX INFORMATION DISPLAY SYSTEMS M.S. Thesis
Karen M. Kempton Dec. 1990 69 p
(AD-A243422) Avail: NTIS HC/MF A04 CSCL 05/8

This thesis culminates in a management plan for determining the effects of combat stress on the man-machine interface of complex information display systems. The objective is to provide to the reader background information detailing the historical development of military attitudes towards combat stress and a survey of the physiological and psychological factors which influence the resolution of this problem. Current research in these areas is discussed with emphasis on research which supports the problem's resolution. The management plan cites those agencies that have a specific background, expertise, and capability to accomplish portions of the research. For concepts requiring further study, individuals within established institutions whom are currently

addressing these areas are suggested. An overall program coordinator is recommended. In conclusion, recommendations for implementation of changes in the areas of training and acquisition are cited. GRA

N92-18481# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Product Assurance Support.
ORGANIZATIONAL ASPECTS FOR PREVENTING HUMAN FAULTS IN SPACE SYSTEMS: SYSTEMS ENGINEERING APPROACHES TO TOTAL QUALITY MANAGEMENT
Hans Joerg Keller 1991 24 p Presented at the ESA Symposium on Space Product Assurance for Europe in the 1990s, Noordwijk, Netherlands, 15-19 Apr. 1991
(MBB-UK-0139-91-PUB; ETN-92-90600) Avail: NTIS HC/MF A03

Approaches for improving the quality of human action, based on the fundamental systems engineering concept of interacting cybernetic control loops, are discussed. Such approaches are designed to result in Total Quality Management (TQM) principles. Motivational topdown conclusions are drawn in considering the modes of human orientation in a surrounding environment. A bottom up approach based on individual failure causes is matched with a standard model of individual responsibility. A more general collective tree model of system engineering tasks provides a preliminary survey of problem roots and respective problem solving branches which are further broken down. ESA

N92-18516# University of Northeastern Illinois, Chicago.
INDIVIDUAL DIFFERENCE EFFECTS IN HUMAN-COMPUTER INTERACTION Final Report
Anita K. Ambardar Oct. 1991 225 p
(Contract MDA903-82-C-0157)
(AD-A243172; ARI-RN-92-05) Avail: NTIS HC/MF A10 CSCL 23/2

The optimum design for human-computer interfaces has become an increasingly important concern. Optimization requires interface to match the characteristics of the user with those of the computer system. At present, it is not clear what user characteristics, beyond a limited set related to experience and training, should be considered. This research project addresses this question. Many forms of human-computer interaction can be viewed as problem-solving activities. Therefore, the cognitive characteristics that affect problem-solving performance may also affect problem-solving performance in the context of user interaction with a computer system. The ideas addressed in this research program were these: (1) how fundamental, inherent individual difference dimensions of cognitive operations might influence interface design; (2) what cognitive dimension, beyond experience, is really important to human-computer interaction; and (3) aside from the classification of users into expert and novice categories, a given interface design is equally good in supporting the problem solving activity of any particular person. Two experiments were conducted. The results revealed that efficiency in using computer systems depends on user cognitive characteristics and design features of computer interface. Further, usage of interface design features significantly interacts with a subject's fundamental cognitive characteristics/cognitive style. GRA

N92-18816# Pennsylvania Univ., Philadelphia. Dept. of Engineering.
MULTIDIMENSIONAL SIGNAL CODING IN THE VISUAL SYSTEM Annual Report No. 1, 1 Nov. 1990 - 31 Oct. 1991
Gershon Buchsbaum 30 Nov. 1991 6 p
(Grant AF-AFOSR-0082-91; AF Proj. 2313)
(AD-A244281; AFOSR-91-1013TR) Avail: NTIS HC/MF A02 CSCL 06/4

This work shows that units in the visual system are tuned to principal components of real world color natural images and provides insight on the strategy the visual system may be using to confront natural imagery. In addition, we developed an efficient coding model for natural time varying imagery in the early visual system. GRA

N92-18927*# FWG Associates, Inc., Tullahoma, TN.
CHEMICAL HAZARDS DATABASE AND DETECTION SYSTEM FOR MICROGRAVITY AND MATERIALS PROCESSING FACILITY (MMPF) Final Report
Jimmy Steele and Robert E. Smith 14 Oct. 1991 67 p
(Contract NAS8-37746)
(NASA-CR-184274; NAS 1.26:184274) Avail: NTIS HC/MF A04 CSCL 06K

The ability to identify contaminants associated with experiments and facilities is directly related to the safety of the Space Station. A means of identifying these contaminants has been developed through this contracting effort. The delivered system provides a listing of the materials and/or chemicals associated with each facility, information as to the contaminant's physical state, a list of the quantity and/or volume of each suspected contaminant, a database of the toxicological hazards associated with each contaminant, a recommended means of rapid identification of the contaminants under operational conditions, a method of identifying possible failure modes and effects analysis associated with each facility, and a fault tree-type analysis that will provide a means of identifying potential hazardous conditions related to future planned missions. Author

N92-19008# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Aerospace Medical Panel.
HELMET MOUNTED DISPLAYS AND NIGHT VISION GOGGLES
Dec. 1991 121 p In ENGLISH and FRENCH Symposium held in Pensacola, FL, 2 May 1991
(AGARD-CP-517; ISBN-92-835-0645-6) Copyright Avail: NTIS HC/MF A06; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Papers covered basic and applied issues related to human factors and device integration. Three papers considered the ergonomics of helmet design and the snugness of fit to the head and the integration of new helmet mounted devices with existing equipment. Two papers considered the effects of novel helmet designs on the pilot's ability to control head position and avoid fatigue. Two papers reported in-flight testing of human performance using novel devices. Several papers considered the human factors of visual performance related to such topics as degree of binocular overlap, overall field of view, and the ability to maintain level flight. Other papers considered issues of the nature of information displayed, including data fused from multiple sources and the design of abstract symbologies that present parameters of flight. For individual titles, see N92-19009 through N92-19023.

N92-19009# IBIS Aerosystems Ltd., Sharnbrook (England).
FIXED WING NIGHT ATTACK EO INTEGRATION AND SENSOR FUSION
Les Evans *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 5 p (For primary document see N92-19008 09-54)
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Discussed here are some of the aeromedical aspects of the development of fixed wing night attack using electro-optic sensors. Addressed are some of the problems encountered when night vision goggles (NVG's) and Forward Looking Infra-Red (FLIR) equipment were integrated into a complete airborne system. The aeromedical problems encountered when NVG's were used in fast jet aircraft are discussed. It was found that helmet fit had to be tight to ensure that the high helmet rotational forces produced by normal accelerations were contained, and also that when wearing NVG's while pulling 'g', a tumbling sensation could be induced in the pilot by head movements. Author

N92-19010# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.
THE DESIGN AND EVALUATION OF FAST-JET HELMET MOUNTED DISPLAYS
A. Karavis and G. J. N. Clarkson *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 8 p (For

primary document see N92-19008 09-54)
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The design philosophy adopted by the Flight Systems Department of the Royal Aerospace Establishment (RAE), Farnborough for its fast-jet helmet display program is discussed. Details are given on the development of two devices and the tests and methods used to meet flight safety measurements. The devices, a Helmet Mounted Sight (HMS) and an Oxygen Mask Mounted Sight (OMMS), each posed different problems due to their inherently dissimilar concepts. Modifications to these devices as a result of ground and air testing to meet flight safety and operational requirements are covered. The ergonomic considerations applicable to the use of these and other head mounted devices when employed as integral components of the weapon system are also discussed. A brief account is given of display design considerations. Two helmet devices were successfully produced for evaluation in a combat environment. Author

N92-19011# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Helicopter Div.
HELICOPTER INTEGRATED HELMET REQUIREMENTS AND TEST RESULTS
Hans-Dieter VonBoehm and Herbert Schreyer *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 17 p Previously announced as N92-12422 (For primary document see N92-19008 09-54)
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Integrated Helmet (IH) requirements for helicopter applications and some test results are given. A modern IH consists of two Image Intensifier Tubes (IIT) and two Cathode Ray Tubes (CRT) with an optical system, including combiners to present binocular images. Additional symbology can be superimposed on the CRT or IIT image. An IH is a further development of a helmet mounted display. A Helmet Mounted Sight (HMS) can steer a sensor platform with a thermal camera, or an air to air missile system. The main helicopter requirements of such a system are given. Author

N92-19012# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.
AN EVALUATION OF THE PROTECTIVE INTEGRATED HOOD MASK FOR ANVIS NIGHT VISION GOGGLE COMPATIBILITY
Mary M. Donohue-Perry and Joseph T. Riegler (Logicon Technical Services, Inc., Dayton, OH.) *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 4 p (For primary document see N92-19008 09-54)
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An evaluation was conducted to determine potential compatibility problems found while using the Protective Integrated Hood Mask (PIHM) with the Aviator's Night Vision Imaging System (ANVIS). The evaluation consisted of field tests performed at Pope Air Force Base using qualified C-130E crewmembers, and laboratory tests conducted at Wright-Patterson Air Force Base. Examinations of horizontal and vertical intensified fields of view, cockpit lighting compatibility, and a subjective evaluation of fit were conducted at Pope Air Force Base. Visual acuity through the ANVIS/PIHM, and distortion and transmissivity of the PIHM visor were determined Wright Patterson Air Force Base. Acuity through ANVIS with and without PIHM was assessed under quarter moon and starlight illuminations. Acuity was tested using 20 percent and 90 percent Landolt C targets depicted in one of four orientations. Overall conclusions were that potential compatibility problems of ANVIS and PIHM can be reduced or eliminated with proper fit and adjustment of the ANVIS/PIHM. Author

N92-19013# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
THE RAF INSTITUTE OF AVIATION MEDICINE PROPOSED HELMET FITTING/RETENTION SYSTEM
John V. Barson and Roger J. Croft *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 5 p (For primary document see N92-19008 09-54)
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The role of the protective flying helmet has expanded from being a device for protecting the flyer from impact and noise hazards to include mounting platforms for vision enhancement devices as well as target sighting and designation systems. A new helmet fitting and/or retention system is described that has the potential to provide a quick and effective method of rendering a good, safe, and stable helmet fit using a minimum number of helmet sizes. The fitting or retention system also provides a relatively consistent eye position for optical systems and allows rapid donning of a chemical defense respirator. Also, the fitting or retention system can be used for a 'one size fits all' helmet while retaining all the features for personnel who are only flying on specific missions and normally are not issued a flight helmet. The system uses a series of straps and an occipital pusher plate to accommodate head length. The height adjustment is provided by a specifically shaped and contoured pad in the top of the helmet which contacts the head in such a way and over a large area to correctly position the helmet vertically on the head for a wide range of pupil-vertex heights. Author

N92-19014# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.
BIOMECHANICAL RESPONSE OF THE HEAD TO G+ ACCELERATIONS: BENEFIT FOR STUDIES IN COMBAT SIMULATORS [REPONSE BIOMECANIQUE DE LA TETE AUX ACCELERATIONS+ GZ: INTERET POUR LES ETUDES EN SIMULATEUR DE COMBAT]
A. Leger, P. Sandor, C. Bourse, and A. Alain *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 9 p In FRENCH Prepared in cooperation with Centre d'Electronique de l'Armement, Bruz (France) (For primary document see N92-19008 09-54)
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Fixed base simulators cannot provide the effect of biomechanical constraints resulting from accelerations, which can pose problems in interpreting studies of helmet mounted sights. One study, in a human centrifuge, of the biomechanical response of the head during an orientation task was conducted for different gradients of variation of acceleration (0.3, 0.6, and 1 G/s). Terminal acceleration in every case plateaued at +5 G. The results obtained show that the stability of the orientation (Mean Quadratic Deviation) on an infinitely collimated target varied from 0.8 deg at 0.3 G/s to more than 2 deg at 1 G/s. The characteristics of the biomechanical response of the head were analyzed. Practical recommendations are made for modeling the effect of the biomechanical constraint at the time of combat simulator studies. Transl. by M.G.

N92-19015# New Orleans Univ., LA. Dept. of Mathematics.
A KINEMATIC MODEL FOR PREDICTING THE EFFECTS OF HELMET MOUNTED SYSTEMS
Terry A. Watkins, M. S. Weiss, D. W. Call, and S. J. Guccione, Jr. (Naval Biodynamics Lab., New Orleans, LA.) *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 7 p (For primary document see N92-19008 09-54)
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A statistical study was made using head kinematic response data from a set of 79 human -X impact acceleration tests. Five volunteer subjects were tested successively in three configurations: (1) no helmet; (2) helmet only; and (3) helmet with weights. The peak acceleration levels ranged from 3 to 10 g. Three kinematic responses, the X and Z components of the linear acceleration and the Y axis angular acceleration, were analyzed. These acceleration curves were fitted with polynomial splines using least squares techniques. The fitted peaks and times to peak were then regressed against sled acceleration, initial head orientation and head/neck anthropometric parameters. Statistical measures

of goodness of fit were highly significant. The regression equations were used to simulate the effects of varying individual parameters (such as total head mass, peak sled acceleration, neck length, etc.). The results show an analytical approach for extrapolating human neck/head kinematics to levels and types of exposure where injury would be expected. Future applications of this modeling technique include analysis of the effects of mass distribution parameters on head/neck dynamic response to +Z vertical impact acceleration. Author

N92-19016# British Aerospace Public Ltd. Co., Bristol (England). Human Factors Dept.

THE EFFECTS UPON VISUAL PERFORMANCE OF VARYING BINOCULAR OVERLAP

G. K. Edgar, K. T. Carr, M. Williams, J. Page, and A. L. Clarke *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 15 p (For primary document see N92-19008 09-54)

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In a helmet mounted display, there is a tradeoff between the binocular overlap of the images presented to each eye and the total field of view. It is therefore desirable to see whether decreasing the binocular overlap (and thus making possible a large total FOV) adversely affects performance. The results are reported of four experiments examining the effects of different binocular overlaps upon performance on a visual search task, and the factors that may explain any differences in the results obtained with different overlap conditions. The results indicated that performance was poorer in all non-100 pct. overlap conditions, and suggested that this decrement in performance could be explained by the presence of depth boundaries introduced by a disparity between the images presented to each eye. Author

N92-19017# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France).

RESTRICTION OF THE FIELD OF VISION: INFLUENCE ON EYE-HEAD COORDINATION DURING ORIENTATION TOWARDS AN ECCENTRIC TARGET [RESTRICTION DU CHAMP DE VISION: INFLUENCE SUR LA COORDINATION OEIL-TETE PENDANT L'ORIENTATION VERS UNE CIBLE EXCENTREE]

Patrick Sandor and Alain Leger *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 6 p In FRENCH (For primary document see N92-19008 09-54)

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Vision in a limited field of vision deviates more and more frequently with use of optronic helmet-mounted systems. The consequences of restricted field on the characteristics of eye-head coordination were studied during a task of orientation toward an eccentric pinpoint target. Three sizes of binocular fields were tested (20 degree, 70 degree, and free field). A pinpoint target is projected onto a round screen in a horizontal plane passing in front of the subject's eyes. The target is presented with three different eccentricities: 45, 65, and 85 degrees. The tests are carried out in two modes: expected and semi-expected, where only the side (left or right) is indicated. The unexpectedness increases the time to acquisition. It is accompanied by an increase in the number of eye motions. The mean and maximum rates of eye motion seem to be maintained constant by means of continual adjustment of eye and head speeds. Amplitude limitation of the eye movements linked to vision restriction is not compensated by use of the entire available field. Generally, only the half-field of vision of the same side as the displacement is used. In conclusion, the results show that restriction of the field of vision modifies the motor behaviors involved in eye-head coordination, especially when the placement of the target is unexpected. An understanding of these mechanisms can eventually contribute to optimizing the use of hement-mounted optronic devices. Author

N92-19018# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.

THE EFFECT OF FIELD-OF-VIEW SIZE ON PERFORMANCE OF A SIMULATED AIR-TO-GROUND NIGHT ATTACK

Robert K. Osgood and Maxwell J. Wells (Logicon Technical Services, Inc., Dayton, OH.) *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 7 p (For primary document see N92-19008 09-54)

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Five experienced fighter pilots flew a simulated, night attack, pop-up bomb delivery, with a flight simulator that had a head-mounted display. The mission was conducted with an aircraft-fixed forward looking infrared sensor (FLIR) or a head-steered FLIR. With the head-steered FLIR, the sensor image was viewed on a helmet-mounted display, whereas, the aircraft-fixed FLIR was presented on a heads-up display (HUD). With both types of sensor, the field of view (FOV) size may affect performance, and to provide data for the determination of the minimum FOV size for helmet-mounted displays (HMD's). With a head-steered sensor, subjects acquired the targets earlier in the mission and released their bomb at a higher altitude. Increasing the size of the FOV also resulted in earlier target acquisition. It is explained how early target acquisition allowed subjects to modify their flight paths and position their aircraft for higher releases. Using criterion, HMD FOV's of 20 and 30 degrees were significantly worse than FOV's of 40, 60, or 80 degrees. Author

N92-19019# Centre d'Etudes et de Recherches de Medecine Aerospatiale, Paris (France). Div. Vision et Ergonomie.

DOES THE FUTURE LIE IN BINOCULAR HELMET DISPLAY? [L'AVENIR EST-IL AU VISUEL DE CASQUE BINOCULAIRE?]

Corinne Roumes, Justin Plantier, and Jean-Pierre Menu *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 9 p In FRENCH (For primary document see N92-19008 09-54)

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The introduction of a binocular capability in helmet displays can be considered as a rebalancing of visual stimuli between the two eyes, given the specific properties of human vision. The potential advantage of binocular helmets rests with the transposition of visual processing capabilities to the conditions of image generation and reconstruction in the helmet's display. Several problems resulting from this transfer are envisaged: some require experimental investigation, especially determining the tolerance of partial binocularity and to the constraints of the aeronautical environment. In view of these difficulties, the role of binocularity in the display can be envisaged differently in the presentation of real world images through sensors or synthesized input, in the framework of an actual flight or of simulation. Author

N92-19020# Center for Night Vision and Electro-Optics, Fort Belvoir, VA.

DESIGN OF HELICOPTER NIGHT PILOTAGE SENSORS: LESSONS LEARNED FROM RECENT FLIGHT EXPERIMENTS AND FIELD ASSESSMENTS Abstract Only

Richard Vollmerhausen, Trang Bui, and Carolyn Nash *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 1 p (For primary document see N92-19008 09-54)

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The Army requirement to fly helicopters at low level at night led to the development and fielding of night vision pilotage sensors. These sensors have included image intensifiers (I sup 2) operating in the near infrared as well as 8 to 12 micron thermal imagers. The design of current pilotage sensors was driven by available technology. There were no clear data for optimum pilotage sensor design, to enable the designer to trade off sensor field of view (FOV) and resolution or to predict the performance sensitivity. The Center of Night Vision and Electro-Optics (CCNVEO) is establishing design criteria for night pilotage sensors. Our program included flight experiments to define sensor characteristics which

optimize flight tasks as well as assessments of the performance of fielded systems. We conclude that terrain flight can be accomplished with reasonable pilot workload using a head-tracked sensor with 40 degree FOV and 0.6 cycles per milliradian (cy/mrad) resolution. Larger FOV or better resolution will lessen workload and improve confidence; however, the ability to resolve scene detail of 0.6 cy/mrad is essential and should not be traded for increased FOV. Furthermore, a pilotage system which provides both thermal and I sup 2 imagery will significantly enhance system capability to support a variety of flight tasks under a wide range of environments. We also conclude that solid state cameras with detector dwell time equal to the standard video field rate are not suitable for use in helicopter pilotage systems. The long dwell time leads to image blur due to the head and scene motion associated with many pilotage tasks. Author

N92-19021# Royal Aircraft Establishment, Farnborough (England). Flight Systems Dept.

HELMET MOUNTED DISPLAYS: HUMAN FACTORS AND FIDELITY

Peter L. N. Naish and Helen J. Dudfield *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 5 p (For primary document see N92-19008 09-54)

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Helmet mounted display (HMD) systems, of the kind able to present what has been termed virtual reality, will not be able to present a completely faithful rendering of the world. This paper shows how non-HMD technology may be used to assess the effects of this deficiency. Three aspects of the helmet mounted system are considered, and experiments are reported, which were designed to determine the degree of reality required in flyable equipment. The areas covered are time lag in the display, the need for color, and the use of 3-D sound. It is concluded that, for the parameters considered, currently available technology is able to produce stimuli which are adequate for the anticipated use of HMDs. Author

N92-19022# Aerospace Medical Research Labs., Wright-Patterson AFB, OH. Human Engineering Div.

ATTITUDE MAINTENANCE USING AN OFF-BORESIGHT HELMET-MOUNTED VIRTUAL DISPLAY

Robert K. Osgood, Eric E. Geiselman, and Christopher S. Calhoun (Logicon Technical Services, Inc., Dayton, OH.) *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 7 p (For primary document see N92-19008 09-54)

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Helmet mounted displays (HMDs) enable flight information to be displayed within the pilot's field of view, regardless of head position in the cockpit. The present research investigates an off boresight HMD (OBHMD), which appears when the pilot's head position is greater than 20 deg from the aircraft's boresight. Nine subjects flew a simulated, low level, high speed, airborne surveillance/reconnaissance mission, while monitoring a hostile adversary aircraft. The results indicate pilots were able to spend more time and look further off boresight with an OBHMD than without one. In addition, missions with an OBHMD produced fewer terrain impacts. Author

N92-19023# Sextant Avionique, Saint Medard en Jalles (France). Div. Visualisation Interface.

DESIGN METHODOLOGY FOR A HELMET DISPLAY: ERGONOMIC ASPECTS [METHODOLOGIE DE CONCEPTION D'UN VISUEL DE CASQUE: LES ASPECTS ERGONOMIQUES]

J. M. Kraus, P. Lacroux, and A. Leger *In* AGARD, Helmet Mounted Displays and Night Vision Goggles Dec. 1991 6 p In FRENCH (For primary document see N92-19008 09-54)

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Purely from the standpoint of vision, the design of a helmet display presents relatively few differences from that of a more classic visualization device such as a head-up display. For the engineer, one of the major difficulties encountered in designing a head mounted system rests in the fact that the carrying structure is far from being as well defined as are the usual supports. The diversity of anatomical and functional specifications of the pilot's head constitutes the source of ergonomic constraints that must be taken into account. The first part of this study addressed the precise identification of the limiting constraints encountered: antropometric and biomechanical constraints as well as those of secureness, comfort, manipulation, and environment. The data from previous research, computer aided design (CAD), and the simultaneous development of ergonomic and physical models permit a global approach to these different problems. The second part of the study exposes the essential aspects of the methodological principles used. In conclusion, reflection on the design development for helmet displays makes apparent the need for early integration of the vision aspects and physical ergonomic requirements. This is a major and indispensable asset that will lead to the creation of a device that will satisfy the requirements imposed by weapon systems and their users. Transl. by M.G.

N92-18988# British Aerospace Aircraft Group, Kingston-upon-Thames (England).

THE MILITARY AIRCREW HEAD SUPPORT SYSTEM (MAHSS)

A. A. Marshall *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)

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N92-18993# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

PHYSIOLOGICAL REQUIREMENTS FOR PARTIAL PRESSURE ASSEMBLIES FOR ALTITUDE PROTECTION

A. J. F. Macmillan *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 7 p (For primary document see N92-18972 09-52)

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N92-18994# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.

FRENCH EQUIPMENT FOR INTEGRATED PROTECTION OF COMBAT AIRCRAFT CREWS: PRINCIPLES AND TESTS AT HIGH ALTITUDES [L'EQUIPEMENT FRANCAIS DE PROTECTION INTEGREE POUR EQUIPAGES D'AVIONS DE COMBAT MODERNE: PRINCIPES ET ESSAIS EN HAUTE ALTITUDE]

Henri Marotte, Henri Vieillefond (Service de Sante des Armees, Paris, France), Damien Lejeune, and Jean-Michel Clere *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 11 p In FRENCH; ENGLISH summary (For primary document see N92-18972 09-52)

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N92-18995# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).

THE EXPERIMENTAL ASSESSMENT OF NEW PARTIAL PRESSURE ASSEMBLIES

D. P. Gradwell *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)

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N92-18996# Laboratoire de Medecine Aerospatiale, Bretigny-sur-Orge (France). Centre d'Essais en Vol.

PHYSIOLOGICAL PROTECTION EQUIPMENT FOR COMBAT AIRCRAFT: INTEGRATION OF FUNCTIONS, PRINCIPAL TECHNOLOGIES [PROTECTION PHYSIOLOGIQUE DES EQUIPAGES D'AVIONS DE COMBAT: INTEGRATION DE FONCTIONS, PRINCIPES TECHNOLOGIQUES]

Henri Marotte, Raymond Beaussant, Richard Zapata (L'Air Liquide, Sassenage, France), Jean-Michel Clere, and Damien Lejeune

In AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 8 p In FRENCH; ENGLISH summary (For primary document see N92-18972 09-52)
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N92-18997# Toronto Univ. (Ontario). Dept. of Mechanical Engineering.
MODEL OF AIR FLOW IN A MULTI-BLADDER PHYSIOLOGICAL PROTECTION SYSTEM
P. S. E. Farrell, D. F. James, and A. A. Goldenberg *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 5 p (For primary document see N92-18972 09-52)
Copyright Avail: NTIS HC/MF A12; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

N92-18998# Royal Aircraft Establishment, Farnborough (England). Aircrew Integration Section.
THE DESIGN AND DEVELOPMENT OF A FULL-COVER PARTIAL PRESSURE ASSEMBLY FOR PROTECTION AGAINST HIGH ALTITUDE AND G
A. E. Hay and Judy E. Aplin *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 6 p (For primary document see N92-18972 09-52)
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N92-18999# Normalair-Garrett Ltd., Yeovil (England). Military Breathing Systems.
ADVANCES IN THE DESIGN OF MILITARY AIRCREW BREATHING SYSTEMS WITH RESPECT TO HIGH ALTITUDE AND HIGH ACCELERATION CONDITIONS
Nigel P. J. Lovett *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 4 p (For primary document see N92-18972 09-52)
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N92-19000# Royal Air Force Inst. of Aviation Medicine, Farnborough (England).
HIGH ALTITUDE HIGH ACCELERATION AND NBC WARFARE PROTECTIVE SYSTEM FOR ADVANCED FIGHTER AIRCRAFT: DESIGN CONSIDERATIONS
A. J. F. Macmillan *In* AGARD, High Altitude and High Acceleration Protection for Military Aircrew Oct. 1991 7 p (For primary document see N92-18972 09-52)
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55 SPACE BIOLOGY

Includes exobiology; planetary biology; and extraterrestrial life.

No abstracts in this category.

59 MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

No abstracts in this category.

60 COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing.

For components see *33 Electronics and Electrical Engineering.*

N92-18010# Washington Univ., Seattle. Northwest Lab. for Integrated Systems.
TRIPTYCH: A NEW FPGA ARCHITECTURE
Carl Ebeling, Gaetano Borriello, Scott A. Hauck, David Song, and Elizabeth A. Walkup Sep. 1991 18 p Sponsored in part by NSF; IBM Corp.; and Sun Microsystems
(Contract N00014-J-91-4041)
(AD-A243621; NW-LIS-91-09-05) Avail: NTIS HC/MF A03
CSCL 12/6

Existing FPGA architectures can be classified along two dimensions: reprogrammable vs. one-time programmable and general-purpose vs. domain specific. The most challenging class of FPGA architectures to design is the reprogrammable, general-purpose FPGA, of which Xilinx is the most well-known example. In this paper we describe Triptych, a new FPGA architecture that addresses two problems of current reprogrammable FPGAs: the large delays incurred in composing large functions and the strict division between routing and logic resources. Our studies indicate that Triptych is more area-efficient than current architectures and has comparable delay characteristics for a large range of circuits that include both data-path elements and control logic. GRA

N92-18172# Argonne National Lab., IL.
ANL STATEMENT OF SITE STRATEGY FOR COMPUTING WORKSTATIONS
K. R. Fenske, ed. Nov. 1991 74 p Revised
(Contract W-31-109-eng-38)
(DE92-004704; ANL/TM-458-Rev-3) Avail: NTIS HC/MF A04

This Statement of Site Strategy describes the procedure at Argonne National Laboratory for defining, acquiring, using, and evaluating scientific and office workstations and related equipment and software in accord with DOE Order 1360.1A (5-30-85), and Laboratory policy. It is Laboratory policy to promote the installation and use of computing workstations to improve productivity and communications for both programmatic and support personnel, to ensure that computing workstations acquisitions meet the expressed need in a cost-effective manner, and to ensure that acquisitions of computing workstations are in accord with Laboratory and DOE policies. The overall computing site strategy at ANL is to develop a hierarchy of integrated computing system resources to address the current and future computing needs of the laboratory. The major system components of this hierarchical strategy are Supercomputers, Parallel computers, Centralized general purpose computers, Distributed multipurpose minicomputers, and Computing workstations and office automation support systems. Computing workstations include personal computers, scientific and engineering workstations, computer terminals, microcomputers, word processing and office automation electronic workstations, and associated software and peripheral devices costing less than $25,000 per item. DOE

N92-18555# Los Alamos National Lab., NM.
MINIATURE-MCA TECHNOLOGY DEVELOPMENTS
J. K. Halbig, S. F. Klosterbuer, M. M. Stephens, and R. S. Biddle 1991 7 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract W-7405-eng-36)
(DE92-003856; LA-UR-91-3559; CONF-911106-36) Avail: NTIS HC/MF A02

We have recently reduced the size of multichannel analyzers (MCA's) and have implemented more features in hardware to relieve software requirements. We built and tested a spectroscopy grade, 4096-channel MCA. Exclusive of amplifier and power supply,

it fits on two boards each approximately 7 by 15 cm. This paper discusses the features and performance of the analyzer and some reasonable applications of these technologies. DOE

61 COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, alogorithms, and specific applications, e.g., CAD/CAM.

N92-18067*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
ANNOTATED BIBLIOGRAPHY OF SOFTWARE ENGINEERING LABORATORY LITERATURE
Linda Morusiewicz (Computer Sciences Corp., Greenbelt, MD.) and Jon D. Valett Nov. 1991 273 p Revised
(NASA-TM-105512; SEL-82-1006; NAS 1.15:105512) Avail: NTIS HC/MF A12 CSCL 09B

An annotated bibliography of technical papers, documents, and memorandums produced by or related to the Software Engineering Laboratory is given. More than 100 publications are summarized. These publications cover many areas of software engineering and range from research reports to software documentation. All materials have been grouped into eight general subject areas for easy reference: The Software Engineering Laboratory; The Software Engineering Laboratory: Software Development Documents; Software Tools; Software Models; Software Measurement; Technology Evaluations; Ada Technology; and Data Collection. Subject and author indexes further classify these documents by specific topic and individual author. Author

N92-18083*# National Aeronautics and Space Administration. Langley Research Center, Hampton, VA.
GRAPHICAL WORKSTATION CAPABILITY FOR RELIABILITY MODELING
Salvatore J. Bavuso, Sandra V. Koppen (Lockheed Engineering and Sciences Co., Hampton, VA.), and Pamela J. Haley Washington Feb. 1992 14 p
(NASA-TM-4317; L-16887; NAS 1.15:4317) Avail: NTIS HC/MF A03 CSCL 09B

In addition to computational capabilities, software tools for estimating the reliability of fault-tolerant digital computer systems must also provide a means of interfacing with the user. Described here is the new graphical interface capability of the hybrid automated reliability predictor (HARP), a software package that implements advanced reliability modeling techniques. The graphics oriented (GO) module provides the user with a graphical language for modeling system failure modes through the selection of various fault-tree gates, including sequence-dependency gates, or by a Markov chain. By using this graphical input language, a fault tree becomes a convenient notation for describing a system. In accounting for any sequence dependencies, HARP converts the fault-tree notation to a complex stochastic process that is reduced to a Markov chain, which it can then solve for system reliability. The graphics capability is available for use on an IBM-compatible PC, a Sun, and a VAX workstation. The GO module is written in the C programming language and uses the graphical kernal system (GKS) standard for graphics implementation. The PC, VAX, and Sun versions of the HARP GO module are currently in beta-testing stages. Author

N92-18094# Los Alamos National Lab., NM.
THE ROYAL ROAD FOR GENETIC ALGORITHMS: FITNESS LANDSCAPES AND GA PERFORMANCE
M. Mitchell, J. H. Holland, and S. Forrest (New Mexico Univ., Albuquerque.) 1991 11 p Presented at the 1st European Conference on Artificial Life, Paris, France, Dec. 1991
(Contract W-7405-eng-36)
(DE92-002541; LA-UR-91-3391; CONF-911266-1) Avail: NTIS HC/MF A03

Genetic algorithms (GA's) play a major role in many artificial-life systems, but there is often little detailed understanding of why the GA performs as it does, and little theoretical basis on which to characterize the types of fitness landscapes that lead to successful GA performance. We propose a strategy for addressing these issues. Our strategy consists of defining a set of features of fitness landscapes that are particularly relevant to the GA, and experimentally studying how various configurations of these features affect the GA's performance along a number of dimensions. We informally describe an initial set of proposed feature classes, describe in detail one such class ('Royal Road' functions), and present some initial experimental results concerning the role of crossover and 'building blocks' on landscapes constructed from features of this class. DOE

N92-18107# National Aeronautical Lab., Tokyo (Japan). Computational Sciences Div.
VECTOR PROCESSING TIME CHART ANALYSIS PROGRAM (VTAP) SIMULATION OF VECTOR PROCESSING COMPUTERS
Hajime Miyoshi, Haruo Hatama, and Yukihiro Karube Feb. 1991 29 p In JAPANESE; ENGLISH summary
(NAL-TR-1094; ISSN-0389-4010) Avail: NTIS HC/MF A03

The Vector Processing Time Chart Analysis Program (VTAP) is a software simulator used to simulate the Vector Processing (VP) of the Fujitsu VP series and other similar computers. This simulator enables the development of enhanced compiler technology and user programming skills, while also advancing data acquisition for the development of new vector computers. Both the VP series' hardware and operations are discussed, with the corresponding VTAP functions and simulation contents being explained. VTAP simulation accuracy was investigated by comparing the VTAP estimated program processing time with the measured time in the VP400 and VP200 models. The obtained VTAP simulation accuracy was 94.5 percent for the VP400 and 98.8 percent for the VP200 simulations. Author

N92-18123*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOFTWARE ENGINEERING LABORATORY (SEL) RELATIONSHIPS, MODELS, AND MANAGEMENT RULES
William Decker, Robert Hendrick (Computer Sciences Corp., Greenbelt, MD.), and Jon D. Valett Feb. 1991 94 p
(NASA-TM-105513; SEL-91-001; NAS 1.15:105513) Avail: NTIS HC/MF A05 CSCL 09B

Over 50 individual Software Engineering Laboratory (SEL) research results, extracted from a review of published SEL documentation, that can be applied directly to managing software development projects are captured. Four basic categories of results are defined and discussed - environment profiles, relationships, models, and management rules. In each category, research results are presented as a single page that summarizes the individual result, lists potential uses of the result by managers, and references the original SEL documentation where the result was found. The document serves as a concise reference summary of applicable research for SEL managers. Author

N92-18124*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOFTWARE ENGINEERING LABORATORY (SEL) DATA AND INFORMATION POLICY
Frank McGarry Apr. 1991 25 p
(NASA-TM-105511; SEL-91-002; NAS 1.15:105511) Avail: NTIS HC/MF A03 CSCL 09B

The policies and overall procedures that are used in distributing and in making available products of the Software Engineering Laboratory (SEL) are discussed. The products include project data and measures, project source code, reports, and software tools. Author

N92-18125*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOFTWARE ENGINEERING LABORATORY (SEL) Ada PERFORMANCE STUDY REPORT
Eric W. Booth (Computer Sciences Corp., Greenbelt, MD.) and

Michael E. Stark Jul. 1991 69 p
(NASA-TM-105510; SEL-91-003; NAS 1.15:105510) Avail: NTIS HC/MF A04 CSCL 09B

The goals of the Ada Performance Study are described. The methods used are explained. Guidelines for future Ada development efforts are given. The goals and scope of the study are detailed, and the background of Ada development in the Flight Dynamics Division (FDD) is presented. The organization and overall purpose of each test are discussed. The purpose, methods, and results of each test and analyses of these results are given. Guidelines for future development efforts based on the analysis of results from this study are provided. The approach used on the performance tests is discussed. Author

N92-18126*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
COLLECTED SOFTWARE ENGINEERING PAPERS, VOLUME 9
Nov. 1991 112 p
(NASA-TM-105508; SEL-91-005-Vol-9; NAS 1.15:105508) Avail: NTIS HC/MF A06 CSCL 09B

This document is a collection of selected technical papers produced by participants in the Software Engineering Laboratory (SEL) from November 1990 through October 1991. The purpose of the document is to make available, in one reference, some results of SEL research that originally appeared in a number of different forums. This is the ninth such volume of technical papers produced by the SEL. Although these papers cover several topics related to software engineering, they do not encompass the entire scope of SEL activities and interests. For the convenience of this presentation, the eight papers contained here are grouped into three major categories: (1) software models studies; (2) software measurement studies; and (3) Ada technology studies. The first category presents studies on reuse models, including a software reuse model applied to maintenance and a model for an organization to support software reuse. The second category includes experimental research methods and software measurement techniques. The third category presents object-oriented approaches using Ada and object-oriented features proposed for Ada. The SEL is actively working to understand and improve the software development process at GSFC. Author

N92-18141# Oak Ridge National Lab., TN.
BLOCK SPARSE CHOLESKY ALGORITHMS ON ADVANCED UNIPROCESSOR COMPUTERS
E. G. Ng and B. W. Peyton Dec. 1991 35 p
(Contract DE-AC05-84OR-21400)
(DE92-004167; ORNL/TM-11960) Avail: NTIS HC/MF A03

As with many other linear algebra algorithms, devising a portable implementation of sparse Cholesky factorization that performs well on the broad range of computer architectures currently available is a formidable challenge. Even after limiting our attention to machines with only one processor, as we have done in this report, there are still several interesting issues to consider. For dense matrices, it is well known that block factorization algorithms are the best means of achieving this goal. We take this approach for sparse factorization as well. This paper has two primary goals. First, we examine two sparse Cholesky factorization algorithms, the multifrontal method and a blocked left-looking sparse Cholesky method, in a systematic and consistent fashion, both to illustrate the strengths of the blocking techniques in general and to obtain a fair evaluation of the two approaches. Second, we assess the impact of various implementation techniques on time and storage efficiency, paying particularly close attention to the work-storage requirement of the two methods and their variants. DOE

N92-18158# Argonne National Lab., IL.
MAN-MACHINE INTERFACE BUILDERS AT THE ADVANCED PHOTON SOURCE
M. D. Anderson 1991 11 p Presented at the FedUNIX/Motif '91, Washington, DC, 8-12 Dec. 1991
(Contract W-31-109-eng-38)
(DE92-004716; ANL/CP-74827; CONF-911271-1) Avail: NTIS HC/MF A03

The Argonne National Laboratory is constructing a 7-GeV Advanced Photon Source for use as a synchrotron radiation source in basic and applied research. The controls and computing environment for this accelerator complex includes graphical operator interfaces to the machine based on Motif, X11, and PHIGS/PEX. Construction and operation of the control system for this accelerator relies upon interactive interface builder and diagram/editor type tools, as well as a run-time environment for the constructed displays which communicate with the physical machine via network connections. This paper discusses our experience with several commercial CUI builders, the inadequacies found in these, motivation for the development of an application-specific builder, and design and implementation strategies employed in the development of our own Man-Machine Interface builder. DOE

N92-18252# National Aeronautical Lab., Bangalore (India). Flight Mechanics and Controls Div.
GRAPHICS FOR INTERACTIVE PC BASED PARAMETER ESTIMATION PACKAGE
C. SunilKumar and Girija Gopalratnam Dec. 1991 22 p
(NAL Proj. FC-8-101)
(NAL-PD-FC-9117) Avail: NTIS HC/MF A03

The capabilities are described of a graphics package developed in Turbo-C for use in interactive flight data analysis using a maximum likelihood estimation method. Flight trajectory analysis can be performed starting from the data base arising from flight dynamic experiments, wind tunnel simulation, and aeroballistic range data. Details are provided of the graphics package developed for plotting the data. Author

N92-18272*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, MD.
SOFTWARE ENGINEERING LABORATORY (SEL) CLEANROOM PROCESS MODEL
Scott Green, Victor Basili, Sally Godfrey, Frank McGarry, Rose Pajerski, and Sharon Waligora (Computer Sciences Corp., El Segundo, CA.) Nov. 1991 67 p
(NASA-TM-105509; NAS 1.15:105509; SEL-91-004) Avail: NTIS HC/MF A04 CSCL 09B

The Software Engineering Laboratory (SEL) cleanroom process model is described. The term 'cleanroom' originates in the integrated circuit (IC) production process, where IC's are assembled in dust free 'clean rooms' to prevent the destructive effects of dust. When applying the clean room methodology to the development of software systems, the primary focus is on software defect prevention rather than defect removal. The model is based on data and analysis from previous cleanroom efforts within the SEL and is tailored to serve as a guideline in applying the methodology to future production software efforts. The phases that are part of the process model life cycle from the delivery of requirements to the start of acceptance testing are described. For each defined phase, a set of specific activities is discussed, and the appropriate data flow is described. Pertinent managerial issues, key similarities and differences between the SEL's cleanroom process model and the standard development approach used on SEL projects, and significant lessons learned from prior cleanroom projects are presented. It is intended that the process model described here will be further tailored as additional SEL cleanroom projects are analyzed. Author

N92-18305*# Michigan Univ., Ann Arbor. Radiation Lab.
APPLICATION OF EDGE-BASED FINITE ELEMENTS AND VECTOR ABCs IN 3D SCATTERING Technical Report, Sep. 1991 - Feb. 1992
A. Chatterjee, J. M. Jin, and John L. Volakis Jan. 1992 23 p
Sponsored in part by Pacific Missile Test Center
(Grant NAG2-541)
(NASA-CR-189845; NAS 1.26:189845; UMICH-025921-24-T)
Avail: NTIS HC/MF A03 CSCL 09B

A finite element absorbing boundary condition (FE-ABC) solution of the scattering by arbitrary 3-D structures is considered. The computational domain is discretized using edge-based tetrahedral

elements. In contrast to the node-based elements, edge elements can treat geometries with sharp edges, are divergence-less, and easily satisfy the field continuity condition across dielectric interfaces. They do, however, lead to a higher unknown count but this is balanced by the greater sparsity of the resulting finite element matrix. Thus, the computation time required to solve such a system iteratively with a given degree of accuracy is less than the traditional node-based approach. The purpose is to examine the derivation and performance of the ABC's when applied to 2-D and 3-D problems and to discuss the specifics of our FE-ABC implementation. Author

N92-18313# Utrecht State Univ. (Netherlands). Dept. of Computer Science.

MECHANISING PROOFS OF PROGRAM TRANSFORMATION RULES

Kaisa Sere and Joakim vonWright (Swedish School of Economics and Business Education, Vaasa, Finland) May 1991 23 p Sponsored by Technology Development Centre of Finland, and Netherlands Organization for Scientific Research

(RUU-CS-91-11; ISSN-0924-3275; ETN-92-90475) Avail: NTIS HC/MF A03

In the refinement calculus, programs are developed in a stepwise fashion by repeated application of transformation rules that preserve total correctness. The formalism and proof of such rules using the HOL (Higher Order Logic) theorem prover are shown. The building of hierarchies of rules, for example for parallelizing algorithms, and how application of these rules can be automated in HOL, are also demonstrated. ESA

N92-18379# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij.

FAST TRIGGERING DEVICE BASED ON PARALLEL MEMORY LOOK UP TUBES TO OPERATE UNDER HIGH MULTIPLICITY OF DETECTED EVENTS, PART 2

B. Yu. Baldin, A. A. Volkov, V. Yu. Glebov, V. N. Evdokimov, and M. S. Ilevskij 1991 14 p In RUSSIAN; ENGLISH summary Submitted for publication

(DE92-605628; IFVE-OEF-91-10-Pt-2) Avail: NTIS HC/MF A03

A device for fast triggering based on parallel memory look up tables is described. It is designed to be used with three tracking detectors (hodoscopes) consisting of 32 elements. The device can analyze up to three coordinates in each hodoscope during the time no more than 160 ns. An integrated circuit K500PY415 as the memory element is used. The first part of the paper describes electronics and software for its testing. The second part describes the design of the hodoscopes, service software, and look up table contents calculations and experimental results. DOE

N92-18414# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

COLAS PROGRAM GENERATOR AND PROGRAM GENERATOR GENERATOR

J. J. P. vanHulzen 22 Jul. 1988 69 p

(NLR-TR-88192-U; ETN-92-90957) Avail: NTIS HC/MF A04

A manual describing the use of two tools for the development of software is presented. The first is the COLAS Program Generator (CPG), which generates the complete control part of programs for interactive use from a specification of the user interaction. In addition, the specifications needed for the COLAS command definition and stubs for the application routines are generated. In this way the definition of the user interaction results in a complete prototype program for evaluation of the interface. By gradually replacing stubs with real application routines the program can be incrementally developed. The specification of the user interaction needed by the CPG is straight forward. The second is the Program Generator Generator (PGG), which can be used to develop program generators. It suffices to specify the syntax of the input for the program generator and a script specifying the output of the program generator. The CPG is an example of a program generator developed with PGG. ESA

N92-18460# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

INPE SPOT STANDARD FORMAT COMPUTER COMPATIBLE TAPE FORMAT SPECIFICATION

Mario Sergio Teixeira Jun. 1991 47 p

(INPE-5254-RPQ/651) Avail: NTIS HC/MF A03

This document defines the format of the computer compatible tapes (CCT) which contain SPOT imagery data acquired from the SPOT series of satellites by the Instituto Nacional de Pesquisas Espaciais. Author

N92-18462# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

MORPHOLOGICAL EDGE DETECTORS: PERFORMANCE EVALUATION

Erivaldo Antonio daSilva (Universidade Estadual de Paulista, Sao Paulo, Brazil) and Nelson Delfino DAvil Mascarenhas Oct. 1991 12 p Presented at the ISPRS-Tsukuba Symposium, Japan, 15-18 May 1991

(INPE-5290-PRE/1690) Avail: NTIS HC/MF A03

Mathematical morphology theory has been recently used as a basis for the proposal of new edge detectors in digital images. An evaluation of the performance of six morphological edge detectors is presented with respect to the sensitivity of their response to edge orientation and edge displacement, in both horizontal and diagonal directions. Author

N92-18517# Metrica, Inc., Bryan, TX.

VALUE OF AIR FORCE EXPERIENCE SOFTWARE PACKAGE: A USER'S MANUAL Final Report, Feb. 1990 - Mar. 1991

Brice M. Stone, Kathryn L. Turner, Larry T. Looper, and Sheree K. Engquist Nov. 1991 52 p

(Contract F41689-88-D-0251)

(AD-A243657; AL-TP-1991-0035) Avail: NTIS HC/MF A04

CSCL 12/5

In an effort to aid Air Force decision-makers in the analysis of the effects of policy changes and economic conditions on the value of Air Force experience, the Value of Air Force Experience (VAFE) software package was developed. Incorporated in VAFE are three human capital value models that can be used to value officer and enlisted experience at various levels of experience and training: (1) full investment cost method (FICM); (2) stochastic rewards valuation method (SRVM); and (3) expected net present value method (ENPVM). FICM is a measure of the present cost of replacing officer or enlisted personnel at a desired level. Estimation of SRVM values represents a monetary valuation of the future expected services to be provided by officers or enlisted personnel from continued active duty. ENPVM uses the cost aspects of FICM and the value perspective of SRVM to produce an expected present value of future service to be rendered during a given service tenure. Output for the FICM module consists of the service state (defined as year of service), replacement number, service state costs, and full replacement codes. Output for both the SRVM and ENPVM modules includes the service state, service state values, and projected SRVM, ENPVM, values. Expanded versions of both the full investment cost model and the expected net present value model, which include military compensation as a maintenance cost, were also incorporated into VAFE. GRA

N92-18730# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.

REASONING WITH FUZZY LOGIC Ph.D. Thesis - Technische Univ.

J. Hellendoorn 16 Jan. 1991 141 p

(NLR-TP-91024-U; ETN-92-90971) Avail: NTIS HC/MF A07

An alternative approach to fuzzy logic, where the meaning of fuzzy sets is taken into account, is proposed. This meaning is used to formulate a number of criteria that can be used to check the theory afterwards. An important deviation from most current theories is the treatment of the so called hedges. Instead of the usual powered hedges approach, a shifted hedges approach is chosen. The shifted hedges approach is worked out in the two inference schemes in fuzzy logic: the compositional rule of inference

and the generalized modus ponens. In the compositional rule of inference, it turns out that the shifted hedges lead to a very elegant theory. It is more difficult in the generalized modus ponens, because the current theory leads to some contradictions. Therefore an alternative way to deal with the generalized modus ponens is presented. ESA

N92-18734# Oak Ridge National Lab., TN.
A PARALLEL ALGORITHM FOR THE NON-SYMMETRIC EIGENVALUE PROBLEM
J. Dongarra and M. Sidani (Tennessee Univ., Knoxville.) Dec. 1991 52 p
(Contract DE-AC05-84OR-21400)
(DE92-004087; ORNL/TM-12003) Avail: NTIS HC/MF A04

This paper describes a parallel algorithm for computing the eigenvalues and eigenvectors of a non-symmetric matrix. The algorithm is based on a divide-and-conquer procedure and uses an iterative refinement technique. DOE

N92-18750# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
ISSUES IN TOOL ACQUISITION Final Report
Paul F. Zarrella, Dennis B. Smith, and Edwin J. Morris Sep. 1991 43 p
(Contract F19628-90-C-0003)
(AD-A244292; CMU/SEI-91-TR-8; ESD-TR-91-8) Avail: NTIS HC/MF A03 CSCL 12/5

This technical report identifies issues involved in the acquisition of computer aided software engineering (CASE) tools. Among the issues identified and discussed are cost, performance, process support, maintenance, data management, tool integration, and standardization. The report concludes with recommendations intended for individuals or groups responsible for acquiring CASE tools. GRA

N92-18751# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
EVALUATION OF PROCESS MODELING IMPROVEMENTS Final Report
Robert W. Krut, Jr. and David P. Wood Apr. 1991 70 p
(Contract F19628-90-C-0003)
(AD-A244293; CMU/SEI-91-TR-5; ESD-TR-91-5) Avail: NTIS HC/MF A04 CSCL 12/5

The SEI has been involved with the development and analysis of software process models for several years. As part of the ongoing process of technology evolution, a study has been undertaken to experimentally implement a set of proposed improvements to the process modeling techniques used by the SEI, and to evaluate the results of that experimentation. As a result of that study, a number of modifications to our techniques have been identified. These modifications enhance the support of software engineering concepts in the development and use of process models. This report describes the study and elaborates upon the advantages and disadvantages of the proposed technique improvements. GRA

N92-18752# Carnegie-Mellon Univ., Pittsburgh, PA. Software Engineering Inst.
A CRITICAL REVIEW OF THE CURRENT STATE OF IPSE TECHNOLOGY Final Report
Alan W. Brown Oct. 1991 28 p
(Contract F19628-90-C-0003)
(AD-A244294; CMU/SEI-91-TR-29; ESD-TR-91-29) Avail: NTIS HC/MF A03 CSCL 12/5

In the past ten years, there has been a great deal of interest in the concept of an Integrated Project Support Environment (IPSE) as a complete, unifying framework of services supporting most (or all) phases of software development and maintenance. In this paper, we evaluate the current state of research work in this area, suggest some reasons for the relative lack of success, and make proposals for ensuring measured progress in the future. GRA

N92-18761# Stanford Univ., CA. School of Education.
A ROLE-FUNCTIONAL MODEL OF DESIGN PROBLEM SOLVING Technical Report, 1 Feb. 1988 - 31 Jul. 1991
Margaret K. Korpi, James G. Greeno, and Douglas N. Jackson, III Dec. 1991 46 p
(Contract N00014-88-K-0152; NR Proj. RR0-4206)
(AD-A244283) Avail: NTIS HC/MF A03 CSCL 12/5

Eight individuals learned about a fictitious vehicle, then designed instruction about it. The individuals were relative novices in instructional design, both in their small amount of professional training in the activity and the novelty of the subject matter. Protocols were coded for subproblems, types of knowing, and problem solving operators. A hypothesis is presented about the organization of problem-solving activity in this design task, in the form of a model in which functional roles are assigned to metaphorical agents in a design committee. GRA

N92-18767# Office of Science and Technology, Washington, DC.
GRAND CHALLENGES: HIGH PERFORMANCE COMPUTING AND COMMUNICATIONS. A REPORT BY THE COMMITTEE ON PHYSICAL, MATHEMATICAL, AND ENGINEERING SCIENCES TO SUPPLEMENT THE PRESIDENT'S FISCAL YEAR 1992 BUDGET Executive Summary
Jan. 1991 65 p
(PB92-102409) Avail: NTIS HC/MF A04 CSCL 09B

This Congressional Report presents an ambitious and well-coordinated research and development program designed to sustain and extend U.S. leadership in all advanced areas of computing and networking. The program not only provides a far-sighted vision for the underlying technologies but also gives recognition to the importance of both human resources and those applications that serve major national needs. It provides for the use of improved computational and communications technologies to contribute to more effective solutions of grand challenge problems. The goal of the Federal High Performance Computing and Communications (HPPCC) Program is to accelerate significantly the commercial availability and utilization of the next generation of high performance computers and networks. GRA

N92-18865# Oak Ridge National Lab., TN.
REDUCTION TO CONDENSED FORM FOR THE EIGENVALUE PROBLEM ON DISTRIBUTED MEMORY ARCHITECTURES
J. J. Dongarra and R. A. vandeGeijn (Texas Univ., Austin.) Jan. 1992 20 p
(Contract DE-AC05-84OR-21400)
(DE92-004291; ORNL/TM-12006) Avail: NTIS HC/MF A03

In this paper, we describe a parallel implementation for the reduction of general and symmetric matrices to Hessenberg and tridiagonal form, respectively. The methods are based on LAPACK sequential codes and use a panel-wrapped mapping of matrices to nodes. Results from experiments on the Intel Touchstone Delta are given. DOE

N92-18876*# Institute for Computer Applications in Science and Engineering, Hampton, VA.
PARALLELIZATION OF IRREGULARLY COUPLED REGULAR MESHES Final Report
Craig Chase, Kay Crowley, Joel Saltz, and Anthony Reeves (Cornell Univ., Ithaca, NY.) Jan. 1992 26 p Submitted for publication Sponsored by IBM
(Contract NAS1-18605; NSF ASC-88-19374)
(NASA-CR-189598; NAS 1.26:189598; ICASE-92-1) Avail: NTIS HC/MF A03 CSCL 09B

Regular meshes are frequently used for modeling physical phenomena on both serial and parallel computers. One advantage of regular meshes is that efficient discretization schemes can be implemented in a straight forward manner. However, geometrically-complex objects, such as aircraft, cannot be easily described using a single regular mesh. Multiple interacting regular meshes are frequently used to describe complex geometries. Each mesh models a subregion of the physical domain. The meshes, or subdomains, can be processed in parallel, with periodic updates

carried out to move information between the coupled meshes. In many cases, there are a relatively small number (one to a few dozen) subdomains, so that each subdomain may also be partitioned among several processors. We outline a composite run-time/compile-time approach for supporting these problems efficiently on distributed-memory machines. These methods are described in the context of a multiblock fluid dynamics problem developed at LaRC. Author

N92-18879# BBN Systems and Technologies Corp., Cambridge, MA.
NETWORK INTERFACE UNIT (NIU) DETAILED DESIGN SPECIFICATION
Jun. 1991 29 p
(Contracts MDA972-89-C-0060; MDA972-89-C-0061)
(AD-A244210; BBN-7622) Avail: NTIS HC/MF A03 CSCL 12/7

The NIU provides the capability to connect dissimilar simulators to an existing SIMNET network. The NIU transforms the existing simulator data into SIMNET PDU's, and provides additional overhead required to support the SIMNET protocol. The NIU allows simulators with nonhomogeneous frame times to be interoperable on the same network. A Simulation Network (SIMNET) Project detailed design specification describing the network interface unit (NIU) software of the SIMNET hardware and software training system for vehicle crew training and operational training is presented. GRA

N92-18896# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
IMAGE SEGMENTATION USING AFFINE WAVELETS M.S. Thesis
Steven E. Smiley 12 Dec. 1991 210 p
(AD-A243918; AFIT/GE/ENG/91D-50) Avail: NTIS HC/MF A10 CSCL 12/9

This thesis discusses the use of the multiresolution representation and radial basis function (RBF) neural networks to segment both FLIR and SAR imagery. The multiresolution approximation coefficients are used as features into the RBF network which learns to distinguish between different cultural and natural regions or objects. The wavelets used are Mallat's spline wavelet and Daubechies' compactly supported wavelets. Additionally, this thesis provides an explanation of wavelets in a tutorial manner. It introduces wavelet theory and discusses two different approaches to generating the multiresolution or wavelet representation. GRA

N92-18899# Mei Associates, Inc., Lexington, MA.
DESIGNING AN ADVANCED INSTRUCTIONAL DESIGN ADVISOR: TRANSACTION SHELL THEORY, VOLUME 6 Interim Report, Aug. 1989 - Feb. 1991
David Merrill and J. M. Spector Dec. 1991 67 p
(Contract F33615-88-C-0003)
(AD-A244062; AL-TP-1991-0017-Vol-6) Avail: NTIS HC/MF A04 CSCL 12/5

The Advanced Instructional Design Advisor (AIDA) is an R&D project being conducted by the Armstrong Laboratory Human Resources Directorate and is aimed at producing automated instructional design guidance for developers of computer-based instructional materials. The process of producing effective computer-based instructional materials is complex and time-consuming. Few experts exist to insure the effectiveness of the process. As a consequence, the Air Force is committed to providing its courseware developers with up-to-date guidance appropriate for the creation of computer-based instruction. The assistance should be provided in an integrated automated setting. This paper addresses the nature of the automated setting in which the assistance is to be provided. GRA

N92-18919# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
ANALYSIS OF THE PERFORMANCE OF MORPHOLOGICAL EDGE DETECTORS WITH RESPECT TO EDGE ORIENTATION AND DISPLACEMENT
Nelson Delfino DAvil Mascarenhas and Erivaldo Antonio daSilva Oct. 1991 13 p Presented at the 3d Simposio Brasileiro de Computacao Grafica e Processamento de Imagens, Gramado, Brazil, 30 May - 1 Jun. 1990 Sponsored in part by Fundacao de Amparo a Pesquisa do Estado de Sao Paulo and Sid Informatica
(INPE-5292-PRE/1697) Avail: NTIS HC/MF A03

Mathematical morphology theory has been recently used as a basis for the proposal of new edge detectors in digital images. The purpose is to present an evaluation of the performance of six morphological edge detectors with respect to sensitivity of their response to edge orientation and edge displacement, in both horizontal and diagonal directions. One example of the application of one of these detectors for the delineation of linear features in urban areas of a LANDSAT image is also presented. Author

N92-18928# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
MIMOSE: A SOFTWARE TOOL TO SUPPORT SIMULATOR DEVELOPMENT
H. deJong 20 Mar. 1990 15 p In DUTCH; ENGLISH summary Presented at the Netherlands Astronautical Society (NVR), 22 Feb. 1990 Sponsored by Netherlands Agency for Aerospace Programs, and ESA
(NLR-TP-90105-U; ETN-92-90967) Avail: NTIS HC/MF A03

An overview of Machine Independent Model Oriented Simulation Environment (MIMOSE) is given. MIMOSE is a computer-based general simulation tool for studying systems that are modeled as concurrent processes that operate on a datapool. MIMOSE has been used to support the development of simulators that represent space manipulator systems. ESA

N92-18939# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
LOGIC PROGRAMMING IN DIGITAL CIRCUIT DESIGN M.S. Thesis
Joseph W. Eicher Dec. 1991 201 p
(AD-A243884; AFIT/GCE/ENG/91D-03) Avail: NTIS HC/MF A10 CSCL 12/5

The design of large, complex digital circuitry requires highly skilled engineers. Much of the time spent by these engineers in the design phase involves tasks that are repetitive, tedious, and slow. If these repetitive tasks are automated, the engineer can spend more time managing the design process and produce a better-quality design in less time. Logic programming can be used to automate design tasks, even those that require a high degree of skill. This thesis investigates several aspects of the digital circuit design process that involve pattern-matching paradigms suitable for encoding in the logic programming language Prolog. GRA

N92-18950*# Nebraska Univ., Lincoln.
MIXTURE BLOCK CODING WITH PROGRESSIVE TRANSMISSION IN PACKET VIDEO. APPENDIX 1: ITEM 2 M.S. Thesis
Yun-Chung Chen Dec. 1989 84 p
(Grant NAG5-916)
(NASA-CR-189957; NAS 1.26:189957) Avail: NTIS HC/MF A05 CSCL 09B

Video transmission will become an important part of future multimedia communication because of dramatically increasing user demand for video, and rapid evolution of coding algorithm and VLSI technology. Video transmission will be part of the broadband-integrated services digital network (B-ISDN). Asynchronous transfer mode (ATM) is a viable candidate for implementation of B-ISDN due to its inherent flexibility, service independency, and high performance. According to the characteristics of ATM, the information has to be coded into discrete cells which travel independently in the packet switching network. A practical realization of an ATM video codec called

Mixture Block Coding with Progressive Transmission (MBCPT) is presented. This variable bit rate coding algorithm shows how a constant quality performance can be obtained according to user demand. Interactions between codec and network are emphasized including packetization, service synchronization, flow control, and error recovery. Finally, some simulation results based on MBCPT coding with error recovery are presented. Author

N92-18951*# Nebraska Univ., Lincoln.
PROGRESSIVE TRANSMISSION OF PSEUDO-COLOR IMAGES. APPENDIX 1: ITEM 4 M.S. Thesis
Andrew C. Hadenfeldt Dec. 1991 84 p
(Grant NAG5-916)
(NASA-CR-189959; NAS 1.26:189959) Avail: NTIS HC/MF A05 CSCL 09B

The transmission of digital images can require considerable channel bandwidth. The cost of obtaining such a channel can be prohibitive, or the channel might simply not be available. In this case, progressive transmission (PT) can be useful. PT presents the user with a coarse initial image approximation, and then proceeds to refine it. In this way, the user tends to receive information about the content of the image sooner than if a sequential transmission method is used. PT finds application in image data base browsing, teleconferencing, medical and other applications. A PT scheme is developed for use with a particular type of image data, the pseudo-color or color mapped image. Such images consist of a table of colors called a colormap, plus a 2-D array of index values which indicate which colormap entry is to be used to display a given pixel. This type of image presents some unique problems for a PT coder, and techniques for overcoming these problems are developed. A computer simulation of the color mapped PT scheme is developed to evaluate its performance. Results of simulation using several test images are presented. Author

N92-19024*# Cornell Univ., Ithaca, NY. Dept. of Computer Science.
PRIMARY-BACKUP PROTOCOLS: LOWER BOUNDS AND OPTIMAL IMPLEMENTATIONS
Navin Budhiraja, Keith Marzullo, Fred B. Schneider, and Sam Toueg Jan. 1992 24 p Sponsored by IBM and Siemens A. G.
(Contract NAG2-593; N00014-91-J-1219; NSF CCR-87-01103; NSF CCR-90-14363; NSF CCR-89-01780; NSF CCR-91-02231)
(NASA-CR-188743; NAS 1.26:188743; TR-92-1265) Avail: NTIS HC/MF A03 CSCL 09B

A formal specification of primary-backup is presented. We then prove lower bounds on the degree of replication, failover time, and worst-case response time to client requests assuming different failure models. Finally, we outline primary-backup protocols and indicate which of our lower bounds are tight. Author

N92-18623# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
THE NEED FOR ACTIVE SOFTWARE PRODUCT ASSURANCE MANAGEMENT FOR SYSTEMS CRITICAL SOFTWARE
Richard Borcz *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 97-102 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18647# Agusta Sistemi S.p.A., Tradate (Italy). Systems and Space Business Unit.
RAMREQ: A COMPUTERIZED TOOL FOR THE DEFINITION OF RAM (RELIABILITY, AVAILABILITY, MAINTAINABILITY) REQUIREMENTS OF COMPLEX SYSTEMS
P. Camerino *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 239-247 Sponsored by ESA/ESTEC (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

62 COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

N92-18052 Department of the Navy, Washington, DC.
MODULAR SIGNAL PROCESSING UNIT Patent Application
Alan J. Davis, inventor (to Navy) and Walter Scheider, inventor (to Navy) 23 Apr. 1991 13 p
(AD-D015170; US-Patent-Appl-SN-693106; Navy-Case-72273)
Avail: NTIS HC/MF A02 CSCL 09/1

A modular signal processing unit capable of being connected in series, parallel or combinations thereof, is provided. Each modular unit is a parallel signal processor that receives input data on a plurality of parallel-signal input lines and sends processed data on the same number of parallel-signal output lines. Each modular signal processing unit has an input gate array for distributing the input data, a plurality of current state-of-the-art single chip, digital signal processors (DSP) to process the distributed data, and an output gate array to organize the processed data onto the parallel-signal output lines. The modular signal processing unit is easily upgraded by replacing the single chip DSP's as such technology improves. GRA

N92-18063# Lawrence Livermore National Lab., CA.
GENERAL PURPOSE PARALLEL SUPERCOMPUTING
D. E. Nielsen, Jr. 19 Jun. 1991 12 p
(Contract W-7405-eng-48)
(DE92-004631; UCRL-ID-108228) Avail: NTIS HC/MF A03

Recent advances in the hardware and software of parallel computers have opened up two new opportunities to focus programmatic resources. First, these new machines enable the smooth transition of an organization's general purpose computing load onto massively parallel processors. Second, these advances allow 'capability' machines to economically serve the 'capacity' needs of a large research or industrial organization. DOE

N92-18140# Oak Ridge National Lab., TN.
NA-NET NUMERICAL ANALYSIS NET
J. Dongarra and B. Rosener (Tennessee Univ., Knoxville.) Dec. 1991 30 p
(Contract DE-AC05-84OR-21400)
(DE92-004166; ORNL/TM-11986) Avail: NTIS HC/MF A03

This report describes a facility called NA-NET created to allow numerical analysts (na) an easy method of communicating with one another. The main advantage of the NA-NET is uniformity of addressing. All mail is addressed to the Internet host 'na-net.ornl.gov' at Oak Ridge National Laboratory. Hence, members of the NA-NET do not need to remember complicated addresses or even where a member is currently located. As long as moving members change their e-mail address in the NA-NET everything works smoothly. The NA-NET system is currently located at Oak Ridge National Laboratory. It is running on the same machine that serves netlib. Netlib is a separate facility that distributes mathematical software via electronic mail. For more information on netlib consult, or send the one-line message 'send index' to netlib(at)ornl.gov. The following report describes the current NA-NET system from both a user's perspective and from an implementation perspective. Currently, there are over 2100 members in the NA-NET. An average of 110 mail messages pass through this facility daily. DOE

N92-18392# Oak Ridge National Lab., TN.
INFORMATION SURVEY FOR MICROCOMPUTER SYSTEMS INTEGRATION
K. A. Hake Dec. 1991 21 p
(Contract DE-AC05-84OR-21400)
(DE92-004021; ORNL/TM-11934) Avail: NTIS HC/MF A03

One goal of the PM-AIM is to provide US Army Project Managers (PMs) and Project Executive Officers (PEOs) with a fundamental microcomputing resource to help perform acquisition information management and its concomitant reporting requirements. Providing key application software represents one means of accomplishing this goal. This workstation would furnish

a broad range of capabilities needed in the PM and PEO office settings as well as software tools for specific project management and acquisition information. Although still in the conceptual phase, the practical result of this exercise in systems integration will likely be a system called the Project Manager's Information System (PMIS) or the AIM workstation. It would include such software as, Project Manager's System Software (PMSS), Defense Acquisition Executive Summary (DAES), and Consolidated Acquisition Reporting System (CARS) and would conform to open systems architecture as accepted by the Department of Defense. ORNL has assisted PM-AIM in the development of technology ideas for the PMIS workstation concept. This paper represents the compilation of information gained during this process. This information is presented as a body of knowledge (or knowledge domain) defining the complex technology of microcomputing. The concept of systems integration or tying together all hardware and software components reflects the nature of PM-AIM's task in attempting to field a PMIS or AIM workstation. DOE

N92-18878# BBN Systems and Technologies Corp., Cambridge, MA.
MULTIRAD NETWORK DESIGN SPECIFICATION
Jun. 1991 22 p
(Contract MDA972-90-C-0061)
(AD-A244208; BBN-7626) Avail: NTIS HC/MF A03 CSCL 12/7

The scope of this document describes all of the simulators and associated equipment on the MULTIRAD network at the Armstrong Laboratory and details of the protocol required to operate the system. The MULTIRAD network uses a distributed simulation approach employing the SIMNET 6.6 protocol with some extensions and modifications. Distributed simulation operates in a particular network environment called a distributed simulation internet. This network environment may consist of a single local area network, or it may include a series of local area networks linked together by a long-haul network. Local area networks are referred to as sites, and the computers at each site (attached to a local area network) are referred to as simulators. GRA

63 CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems.

For related information see also *54 Man/System Technology and Life Support.*

N92-18013# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
FUNCTION PREDICTION USING RECURRENT NEURAL NETWORKS M.S. Thesis
Mike Hinman Dec. 1991 111 p
(AD-A243625; AFIT/GEO/ENG/91D-02) Avail: NTIS HC/MF A06 CSCL 12/2

A fully recurrent neural network was applied to the function prediction problem. The real-time recurrent learning (RTRL) algorithm was modified and tested for use as a viable function predictor. The modification gave the algorithm a variable learning rate and a linear/sigmoidal output selection. Verifying the networks ability to temporally learn both the classic exclusive-OR (XOR) problem and the internal state problem, the network was then used to simulate the frequency response of a second order IIR lowpass Butterworth filter. The recurrent network was then applied to two problems: head position tracking, and voice data reconstruction. The accuracy at which the network predicted the pilot's head position was compared to the best linear statistical prediction algorithm. The application of the network to the reconstruction of voice data showed the recurrent network's ability to learn temporally encoded sequences, and make decisions as to whether or not a speech signal sample was considered a fricative or a voiced portion of speech. GRA

N92-18191*# Boeing Commercial Airplane Co., Seattle, WA. Flight Deck Research.
FLIGHT DECK ENGINE ADVISOR Final Report
W. D. Shontz, R. M. Records, and D. R. Antonelli Feb. 1992 145 p
(Contract NAS1-18027)
(NASA-CR-189562; NAS 1.26:189562) Avail: NTIS HC/MF A07 CSCL 09B

The focus of this project is on alerting pilots to impending events in such a way as to provide the additional time required for the crew to make critical decisions concerning non-normal operations. The project addresses pilots' need for support in diagnosis and trend monitoring of faults as they affect decisions that must be made within the context of the current flight. Monitoring and diagnostic modules developed under the NASA Faultfinder program were restructured and enhanced using input data from an engine model and real engine fault data. Fault scenarios were prepared to support knowledge base development activities on the MONITAUR and DRAPhyS modules of Faultfinder. An analysis of the information requirements for fault management was included in each scenario. A conceptual framework was developed for systematic evaluation of the impact of context variables on pilot action alternatives as a function of event/fault combinations. Author

N92-18219# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
IDENTIFICATION AND CONTROL OF DYNAMIC SYSTEMS VIA ADAPTIVE NEURAL NETWORKS
E. ColinaMorales and N. Mort Jul. 1991 34 p Sponsored by Univ. de Los Andes, and Maraven S.A. Petroleos de Venezuela
(RR-433; ETN-92-90651) Avail: NTIS HC/MF A03

Various applications of multilayer perceptron neural networks are studied in order to identify and control certain types of dynamic systems. Two different methods for updating the weights of the neural network are explored. A variable structure control formulation and a gradient descent approach are considered. Both methods are digitally simulated and their performances in parameter identification are compared. An adaptive model reference control scheme is presented along with an indirect self-tuning control scheme based on a multilayer perceptron neural network. Examples of the simulated responses for both schemes are obtained using different linear plans. ESA

N92-18300*# Environmental Research Inst. of Michigan, Ann Arbor. Space Automation and Robotics Center.
RoMPS CONCEPT REVIEW AUTOMATIC CONTROL OF SPACE ROBOT, VOLUME 2
M. E. Dobbs Oct. 1991 80 p
(Grant NAG5-1517)
(NASA-CR-189796; ERIM-238800-2-T-Vol-1; NAS 1.26:189796)
Avail: NTIS HC/MF A05 CSCL 09B

Topics related to robot operated materials processing in space (RoMPS) are presented in view graph form and include: (1) system concept; (2) Hitchhiker Interface Requirements; (3) robot axis control concepts; (4) Autonomous Experiment Management System; (5) Zymate Robot Controller; (6) Southwest SC-4 Computer; (7) oven control housekeeping data; and (8) power distribution. Author

N92-18301*# Environmental Research Inst. of Michigan, Ann Arbor. Space Automation and Robotics Center.
NASA GODDARD SPACE FLIGHT CENTER ROBOTIC PROCESSING SYSTEM PROGRAM AUTOMATION SYSTEMS, VOLUME 2 Interim Design Report
M. E. Dobbs Oct. 1991 48 p
(Grant NAG5-1517)
(NASA-CR-189797; ERIM-238800-2-T-Vol-2; NAS 1.26:189797)
Avail: NTIS HC/MF A03 CSCL 09B

Topics related to robot operated materials processing in space (RoMPS) are presented in view graph form. Some of the areas covered include: (1) mission requirements; (2) automation management system; (3) Space Transportation System (STS)

Hitchhicker Payload; (4) Spacecraft Command Language (SCL) scripts; (5) SCL software components; (6) RoMPS EasyLab Command & Variable summary for rack stations and annealer module; (7) support electronics assembly; (8) SCL uplink packet definition; (9) SC-4 EasyLab System Memory Map; (10) Servo Axis Control Logic Suppliers; and (11) annealing oven control subsystem. Author

N92-18338# Oxford Univ. (England). Dept. of Engineering Science.
STABLE GENERALIZED PREDICTIVE CONTROL: AN ALGORITHM WITH GUARANTEED STABILITY
B. Kouvaritakis, J. A. Rossiter, and A. O. T. Chang 1991 35 p Sponsored by Science Research Council; Croucher Foundation; and Overseas Student Research Scheme
(OUEL-1883/91; ETN-92-90908) Avail: NTIS HC/MF A03

An idea that removes the stability problem but retains and further simplifies the main features of Generalized Predictive Control (GPC) is proposed. In particular, a characterization of the class of all stabilizing feedback controllers is used as a first step in order to achieve internal stability. The output prediction and optimization steps used in GPC are then performed but the degrees of freedom are defined to be future values of the reference signal rather than values of future control increments. The stabilizing feedback configuration and the algorithms are described. Treatment of robustness is presented. Results are illustrated by means of three numerical results. ESA

N92-18407# Pacific Northwest Lab., Richland, WA.
TOWARDS THE DEVELOPMENT OF MULTILEVEL-MULTIAGENT DIAGNOSTIC AIDS
R. C. Stratton and D. B. Jarrell Oct. 1991 25 p Presented at the 2nd International Workshop on Principles of Diagnosis, Milano, Italy, 14-16 Oct. 1991
(Contract DE-AC06-76RL-01830)
(DE92-002701; PNL-SA-19551; CONF-9110272-1) Avail: NTIS HC/MF A03

Presented here is our methodology for developing automated aids for diagnosing faults in complex systems. We have designed these aids as multilevel-multiagent diagnostic aids based on principles that should be generally applicable to any complex system. In this methodology, 'multilevel' refers to information models described at successful levels of abstraction that are tied together in such a way that reasoning is directed to the appropriate level as determined by the problem solving requirements. The concept of 'multiagent' refers to the method of information processing within the multilevel model network; each model in the network is an independent information processor, i.e., an intelligent agent. DOE

N92-18413# Sheffield Univ. (England). Dept. of Control Engineering.
OPTIMAL CONTROL AND STABILIZATION FOR NONLINEAR SYSTEMS
S. P. Banks and K. J. Mhana Feb. 1991 28 p
(RR-424; ETN-92-90646) Avail: NTIS HC/MF A03

The optical control and stabilization of nonlinear systems of the form $x = A(x)x + B(x)u$ is considered. Explicit expressions for the control are developed. It is shown that if (A(x), B(x)) is stabilized for all x and the matrix valued functions A(x) and B(x) satisfy certain boundedness conditions on their derivatives, then a local infinite time control will stabilize the system. An explicit formula for control is obtained by solving the Riccati equation when A(x) is symmetric. The control system developed is shown to be an optical control if (Q, A(x)) is observable for all x and A(x) and B(x) are analytic. Application of these results to flight control systems is suggested. ESA

N92-18514# Lawrence Livermore National Lab., CA.
APPLICATIONS OF INTELLIGENT TELEROBOTIC CONTROL
C. J. Herget, E. L. Grasz, and R. D. Merrill Oct. 1991 7 p
(Contract W-7405-eng-48)
(DE92-004655; UCRL-JC-108589) Avail: NTIS HC/MF A02

The telerobotics laboratory at Lawrence Livermore National Laboratory is a facility for developing and testing new concepts in robotics controls. Research and development is being conducted in computer vision; adaptive control; software architectures for real-time, intelligent control; artificial neural networks; fuzzy logic controllers; telepresence; and path planning and collision avoidance. The equipment in the telerobotics laboratory includes a six degree of freedom articulating robot arm with controller, gripper, and force and torque sensor; a 3D CAD workstation with software to model the work cell environment and simulate the robot dynamics; a six degree of freedom forceball for operator input to the telerobotics controller and the robot simulation; and a computer with a real-time operating system. Soon to be added are a 3D viewing system and a force reflecting hand controller. This paper describes one of the research and development efforts currently in progress on this program. DOE

N92-18669# Stanford Linear Accelerator Center, CA.
GLAD: A GENERIC LATTICE DEBUGGER
M. J. Lee Nov. 1991 4 p Presented at the International Conference on Accelerator and Large Experimental Physics Control Systems, Tsukuba, Japan, 11-15 Nov. 1991
(Contract DE-AC03-76SF-00515)
(DE92-004949; SU-SLAC-PUB-5700; CONF-911116-14) Avail: NTIS HC/MF A01

Today, numerous simulation and analysis codes exist for the design, commission, and operation of accelerator beam lines. There is a need to develop a common user interface and database link to run these codes interactively. This paper will describe a proposed system, GLAD (Generic LAttice Debugger), to fulfill this need. Specifically, GLAD can be used to find errors in beam lines during commissioning, control beam parameters during operation, and design beam line optics and error correction systems for the next generation of linear accelerators and storage rings. DOE

N92-18732# Technische Univ., Delft (Netherlands).
PREDICTIVE CONTROL: A UNIFIED APPROACH Ph.D. Thesis
Aloisius Ronald Mari Soeterboek 1990 362 p
(ETN-92-90973) Avail: NTIS HC/MF A16

A unified approach to predictive controller design for linear Single Input Single Output (SISO) processes is adopted by using a general process model and a general criterion function. The general process model unifies several models such as Auto Regressive Integrated Moving Average Exogeneous (ARIMAX) and impulse response models. The process model includes a general noise or disturbance model. The resulting controller is called the Unified Predictive Controller (UPC). Special attention is paid to the design of the UPC and to the influence of the noise model on the closed loop system. Two industrial applications show that the use of the UPC is not restricted to simulations. ESA

N92-18938# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
MULTI-LAYERED FEEDFORWARD NEURAL NETWORKS FOR IMAGE SEGMENTATION Ph.D. Thesis
Gregory L. Tarr Dec. 1991 156 p
(AD-A243873; AFIT/DS/ENG/91-01) Avail: NTIS HC/MF A08 CSCL 12/9

Artificial neural network image segmentation techniques are examined. The biological inspired cortex transform is examined as a means to preprocess images for segmentation and classification. A generalized neural network formalism is presented as a means to produce common pattern recognition processing techniques in a single iterable element. Several feature reduction preprocessing techniques, based on feature saliency, Karhunen-Loeve transformation and identity networks are tested and compared. The generalized architecture is applied to a problem in image segmentation, a tracking of high-value fixed tactical targets. A generalized architecture for neural networks is developed based on the second order terms of the input vector. The relation between several common neural network paradigms is demonstrated using the generalized neural network. The architecture is demonstrated to allow implementation of many feedforward networks and several

preprocessing techniques as well. Because of the limited resources and large feature vectors associated with classification problems, several methods are tested to limit the size of the input feature vector. A feature saliency metric, weight saliency, is developed to assign relative importance to the individual features. The saliency metric is shown to be significantly easier to compute than previous methods. Several neural network implementations of identity networks are tested as a means to reduce the size of the feature vectors presented to classification networks. GRA

N92-18952# RRC, Inc., Bryan, TX.
NEURAL NETWORKS AND THEIR APPLICATION TO AIR FORCE PERSONNEL MODELING Final Report, Sep. 1989 - May 1991
Vince L. Wiggins, Larry T. Looper, and Sheree K. Engquist Nov. 1991 60 p
(Contract F41689-88-D-0251)
(AD-A243802; AL-TR-1991-0031) Avail: NTIS HC/MF A04
CSCL 12/4

Neural network technology has recently demonstrated capabilities in areas important to personnel research such as statistical analysis, decision modeling, control, and forecasting. The present investigation indicates that three different neural network architectures are particularly suited to modeling many aspects of the Air Force personnel system: back propagation, learning vector quantization, and probabilistic neural networks. The primary advantage of neutral networks is their ability to derive nonlinear and interacting relationships among model variables. Two areas investigated in order to evaluate this capability were airmen reenlistment decisions and airman inventory modeling. GRA

64 NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

N92-18045# Oxford Univ. (England). Robotics Research Group.
RELATIVE MOTION AND POSE FROM ARBITRARY PLANE CURVES
C. A. Rothwell, A. Zisserman, C. I. Marinos, D. A. Forsyth, and J. L. Mundy 1991 17 p Sponsored by GE; Science Research Council; and British Petroleum Co. Ltd.
(OUEL-1880/91; ETN-92-90907) Avail: NTIS HC/MF A03

The recovery of the position and orientation of a pair of known coplanar conics that form a single perspective image is shown. A number of methods for determining this relationship are described and compared. A simple four point back projection model, and other transformation invariants are used. These results can be applied to arbitrary plane curves using an invariant fitting technique and to higher order algebraic curves. Examples of pose determination for both synthetic data and real images of conic and non conic objects are shown. For example, pose for a gasket containing non coning curves is recognized and determined. The methods for stability and for accuracy are assessed against an accepted standard, Tsai's calibration method. Using such methods is concluded to enable accurate pose determination for arbitrary plane curves. ESA

N92-18060# Mound Lab., Miamisburg, OH.
THREE-DIMENSIONAL OPERATIONAL INTERPOLATION
G. L. Silver 12 Dec. 1991 53 p
(Contract DE-AC04-88DP-43495)
(DE92-004581; MLM-3722) Avail: NTIS HC/MF A04

The operational method for interpolating experimental data is extended into three dimensions. An exponential method or a polynomial method can be used. Equations for two pyramids and two prisms are derived as illustrations. DOE

N92-18127# International Centre for Theoretical Physics, Trieste (Italy).
THE EQUATOR MAP AND THE NEGATIVE EXPONENTIAL FUNCTIONAL
Hong Min-Chun Jun. 1991 15 p
(DE92-609036; IC-91/141) Avail: NTIS HC/MF A03

We define a negative exponential harmonic map from the ball B(sup n) of R(sup n) into the sphere S(sup n) of R(sup n+1). And we prove that the equator map u(sup *) = (x/x, 0) is a negative exponential harmonic map, but not stable for the negative exponential functional when n is greater than or = 2. Moreover, if we consider maps from a ball B(sup n) into the unit sphere S(sup m) of R(sup m) where m is greater than or = 2, we prove that no nonconstant map can reach either the minimum or the maximum of the negative exponential functional. DOE

N92-18128# International Centre for Theoretical Physics, Trieste (Italy).
ON THE CONFORMAL EQUIVALENCE OF HARMONIC MAPS AND EXPONENTIALLY HARMONIC MAPS
Hong Min-Chun Jun. 1991 6 p
(DE92-609037; IC-91/142) Avail: NTIS HC/MF A02

Suppose that (M,g) and (N,h) are compact smooth Riemannian manifolds without boundaries. For m = dim M is greater than or = 3, and Phi : (M,g) yields (N,h) is exponentially harmonic, there exists a smooth metric g-tilde conformally equivalent to g such that Phi : (M,g-tilde) yields (N,h) is harmonic. DOE

N92-18129# International Centre for Theoretical Physics, Trieste (Italy).
SOME APPLICATION OF THE MODEL OF PARTITION POINTS ON A ONE-DIMENSIONAL LATTICE
R. Mejdani Jul. 1991 18 p
(DE92-609038; IC-91/143) Avail: NTIS HC/MF A03

We have shown that by using a model of the gas of partition points on one-dimensional lattice, we can find some results about the enzyme kinetics or the average domain-size, which we have obtained before by using a correlated Walks' theory or a probabilistic (combinatoric) way. We have discussed also the problem related with the spread of an infection of disease and the stochastic model of partition points. We think that this model, as a very simple model and mathematically transparent, can be advantageous for other theoretical investigations in chemistry or modern biology. DOE

N92-18130# International Centre for Theoretical Physics, Trieste (Italy).
GEOMETRIC CORRELATIONS AND MULTIFRACTALS
R. E. Amritkar Jul. 1991 35 p
(DE92-609039; IC-91/154) Avail: NTIS HC/MF A03

There are many situations where the usual statistical methods are not adequate to characterize correlations in the system. To characterize such situations we introduce mutual correlation dimensions which describe geometric correlations in the system. These dimensions allow us to distinguish between variables which are perfectly correlated with or without a phase lag, variables which are uncorrelated and variables which are partially correlated. We demonstrate the utility of our formalism by considering two examples from dynamical systems. The first example is about the loss of memory in chaotic signals and describes auto-correlations while the second example is about synchronization of chaotic signals and describes cross-correlations. DOE

N92-18147# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
MULTICHANNEL SCATTERING PROBLEM AS A NONLINEAR BOUNDARY VALUE PROBLEM
T. Zhanlav and I. V. Puzynin 1990 9 p In RUSSIAN; ENGLISH summary
(DE92-609057; JINR-R-11-90-382) Avail: NTIS HC/MF A02

The computational scheme for solving the scattering problem based on its representation as a nonlinear boundary value problem for a multichannel case is generalized. The spline-function method

and the continuous analog of the Newton method including the perturbation operator are used for the numerical solution of the obtained nonlinear problem. The proposed scheme has an accuracy of 0(h sup 4), where h is a step of a uniform mesh. DOE

N92-18150# International Centre for Theoretical Physics, Trieste (Italy).
CORRELATION FUNCTIONS AND SCHWINGER-DYSON EQUATIONS FOR PENNER'S MODEL
N. Chair and S. Panda May 1991 9 p
(DE92-609086; IC-91/100) Avail: NTIS HC/MF A02

The free energy of Penner's model exhibits logarithmic singularity in the continuum limit. We show, however, that the one and two point correlators of the usual loop-operators do not exhibit logarithmic singularity. The continuum Schwinger-Dyson equations involving these correlation functions are derived and it is found that within the space of the corresponding couplings, the resulting constraints obey a Virasoro algebra. The puncture operator having the correct (logarithmic) scaling behavior is identified. DOE

N92-18159# Argonne National Lab., IL.
RATIONALE FOR GUARANTEED ODE DEFECT CONTROL
R. M. Corless (University of Western Ontario, London.) and G. F. Corliss 1991 11 p Presented at the SCAN '91: International Symposium on Computer Arithmetic and Scientific Computing, Oldenburg, Fed. Republic of Germany, 1-4 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-004721; ANL/CP-74794; CONF-9110300-2) Avail: NTIS HC/MF A03

We introduce a modification of existing algorithms that allows easier analysis of numerical solutions of ordinary differential equations. We relax the requirement that the specified problem be solved, and instead solve a 'nearby' problem exactly, in Wilkinson's tradition of backward error analysis. The precise meaning of 'nearby' is left to the user. This inexpensive algorithm sublimates the well known difficulties associated with the propagation of accumulated error and avoids the difficulty of exponential growth of inclusion widths associated with internal techniques. No claim is made for the accuracy with which the specified problem is solved. It is shown that often no such claim is necessary. DOE

N92-18165# International Centre for Theoretical Physics, Trieste (Italy).
ASPECTS OF W(INFINITY) SYMMETRY
E. Sezgin Aug. 1991 24 p
(DE92-609096; IC-91/206; CTP-TAMU-9/91) Avail: NTIS HC/MF A03

We review the structure of W sub infinity algebras, their super and topological extensions, and their contractions down to (super) w sub infinity. Emphasis is put on the field theoretic realizations of these algebras. We also review the structure of w sub infinity and W sub infinity gravities and comment on various applications of W sub infinity symmetry. DOE

N92-18218# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
GLOBAL ANALYSIS AND MODEL VALIDATION IN NONLINEAR SYSTEM IDENTIFICATION
B. R. Haynes (Leeds Univ., England) and S. A. Billings Apr. 1991 45 p Sponsored by Science Research Council
(RR-429; ETN-92-90650) Avail: NTIS HC/MF A03

The analysis of parametrized nonlinear models is considered. Emphasis is placed on models produced as a result of applying nonlinear system identification techniques. A qualitative approach is taken which calls upon ideas from bifurcation theory which, when combined with an existing numerical method, enables the analysis of a wide variety of nonlinear model forms. The combination of qualitative and numerical aspects provides a flexible framework for analysis at the same time as providing a global perspective that is difficult to achieve using analytical methods alone. ESA

N92-18266# Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics.
HOW TO ESCAPE A SAWTOOTH
G. Troll Jan. 1991 62 p
(DE92-603621; WIS-PH-91/02) Avail: NTIS HC/MF A04

We discuss a 2-parameter family of truncated sawteeth serving as a simple scattering model which shows a transition from a regular to chaotic dynamics. The transition arises as a homoclinic bifurcation of an atypical ('cut-off') type in phase space and as a breaking of symmetry in a symbolic dynamics. DOE

N92-18276# International Centre for Theoretical Physics, Trieste (Italy).
HERMITIAN SECTIONAL CURVATURES ON HERMITIAN MANIFOLD
G. Ganchev, V. Michova, and S. Ivanov May 1991 33 p Submitted for publication
(DE92-603612; IC-91/40) Avail: NTIS HC/MF A03

The basic classes of Hermitian manifolds with respect to the Hermitian curvature tensor are introduced and the equivalence theorems for Hermitian manifolds with flat Hermitian connection and parallel torsion tensor are proved. DOE

N92-18277# International Centre for Theoretical Physics, Trieste (Italy).
CONNECTIONS AND CURVATURES ON COMPLEX RIEMANNIAN MANIFOLDS
G. Ganchev and S. Ivanov May 1991 46 p Submitted for publication
(DE92-603613; IC-91/41) Avail: NTIS HC/MF A03

Characteristic connection and characteristic holomorphic sectional curvatures are introduced on a complex Riemannian manifold (not necessarily with holomorphic metric). For the class of complex Riemannian manifolds with holomorphic characteristic connection, a classification of the manifolds with (pointwise) constant holomorphic characteristic curvature is given. It is shown that the conformal geometry of complex analytic Riemannian manifolds can be naturally developed on the class of locally conformal holomorphic Riemannian manifolds. Complex Riemannian manifolds locally conformal to the complex Euclidean space are characterized with zero conformal fundamental tensor and zero conformal characteristic tensor. DOE

N92-18278# International Centre for Theoretical Physics, Trieste (Italy).
ERROR ESTIMATES IN PROJECTIVE SOLUTIONS OF THE RADON EQUATION
Mbara-Saman Lubuma Apr. 1991 15 p Submitted for publication
(DE92-603614; IC-91/56) Avail: NTIS HC/MF A03

The model Radon equation is the integral equation of the second kind defined by the interior limits of the electrostatic double layer potential relative to a curve with one angular point and characterized by the non-compactness of the operator with respect to the maximum norm. It is shown that the solution to this equation is decomposable into a regular part and a finite linear combination of intrinsic singular functions. The maximal regularity of the solution and explicit formulae for the coefficients of the singular functions are given. The regularity permits to specify how slow the convergence of the classical projection method is, while the above mentioned formulae lead to modified projection methods of the Dual Singular Function Method type, with better approximations for the solution and for the coefficients of singularities. DOE

N92-18279# International Centre for Theoretical Physics, Trieste (Italy).
ARITHMETIC, GEOMETRY AND DYNAMICS IN THE UNIT TANGENT BUNDLE OF THE MODULAR ORBIFOLD
Alberto Verjovsky May 1991 37 p Submitted for publication
(DE92-603620; IC-91/94) Avail: NTIS HC/MF A03

The interplay between the geometry, dynamics and arithmetic of the modular orbifold are studied. The Riemann hypothesis looms upon this structure. DOE

N92-18297# International Centre for Theoretical Physics, Trieste (Italy).
CLASSICAL SOLUTIONS OF TWO DIMENSIONAL STOKES PROBLEMS ON NON SMOOTH DOMAINS. 1: THE RADON INTEGRAL OPERATORS
Mbaro-Saman Lubuma May 1991 29 p Submitted for publication
(DE92-603619; IC-91/92) Avail: NTIS HC/MF A03

The applicability of the Neumann indirect method of potentials to the Dirichlet and Neumann problems for the two-dimensional Stokes operator on a non-smooth boundary Gamma is subject to two kinds of sufficient and/or necessary conditions on Gamma. The first one, occurring in electrostatic, is equivalent to the boundedness on C Gamma of the velocity double layer potential W as well as to the existence of jump relations of potentials. The second condition, which forces Gamma to be a simple rectifiable curve and which, compared to the Laplacian, is a stronger restriction on the corners of Gamma, states that the Fredholm radius of W is greater than 2. Under these conditions, the Radon boundary integral equations defined by the above mentioned jump relations are solvable by the Fredholm theory; the double (for Dirichlet) and the single (for Neumann) layer potentials corresponding to their solutions are classical solutions of the Stokes problems. DOE

N92-18324# International Centre for Theoretical Physics, Trieste (Italy).
MONADS, CONNECTIONS AND COMPACTIFICATIONS
Le Minh Hoang Jan. 1991 17 p
(DE92-603609; IC-91/3) Avail: NTIS HC/MF A03

Using the monad construction of stable vector bundles and semi-stable torsion free sheaves on the complex projective plan, we describe natural hermitian complex connections for the vector bundles and interpret the sheaves on the boundary of compactifications of their moduli spaces in terms of singular connections with isolated singularity. DOE

N92-18325# International Centre for Theoretical Physics, Trieste (Italy).
RIGIDITY OF INVARIANT COMPLEX STRUCTURES
Isabel Dotti Miatello Mar. 1991 25 p Submitted for publication
(DE92-603610; IC-91/33) Avail: NTIS HC/MF A03

A Kaehler solvmanifold is a connected Kaehler manifold (M,j, less than, greater than) which admits a transition solvable group R of automorphisms. The problem considered in this paper is related to the number of isomorphism classes of Kaehler structures (j, less than, greater than) on M turning it into a Kaehler solvmanifold. DOE

N92-18326# International Centre for Theoretical Physics, Trieste (Italy).
Q-DEFORMED DIFFERENTIAL OPERATOR ALGEBRA AND NEW BRAID GROUP REPRESENTATION
Lu-Yu Wang, Jiang-Hui Dai, and Jun Zhang Jan. 1991 9 p Sponsored in part by NSF of China
(DE92-603611; IC-91/4) Avail: NTIS HC/MF A02

It is proved that the q-deformed differential operator algebra introduced is consistent with quantum hyperplane described by Wess and Zumino. At the same time, a new braid group representation associated with sl(sub q)(2) is obtained by adding the terms of weight conservation to the standard universal R-matrix. DOE

N92-18327# International Centre for Theoretical Physics, Trieste (Italy).
A NOTE ON LAGRANGIAN SYSTEMS WITH SINGULAR POTENTIAL
Wu Shaoping and Li Shujie May 1991 7 p
(DE92-603618; IC-91/88) Avail: NTIS HC/MF A02

Applying a variational theorem for a functional defined in an open subset of the space, given by Majer, we prove the existence of infinitely many solutions with prescribed period for singular Lagrangian system, where the Lagrangian L has the form L(t,x,y)=1/2 the summation of a sub ij (x)y sub i y sub j - W(t,x) - H(t,x) where W is singular at 0 and bounded from above, H is subquadratic in x. As W is singular at the boundary of a bounded open set Omega, the same result holds without the restriction on the growth of H. DOE

N92-18375# International Centre for Theoretical Physics, Trieste (Italy).
SCHWINGER-DYSON EQUATIONS FOR THE TWO-MATRIX MODEL AND W3 ALGEBRA
E. Gava and K. S. Narain Apr. 1991 11 p
(DE92-603667; IC-91/62) Avail: NTIS HC/MF A03

The continuum Schwinger-Dyson equations for the two-matrix model, around the Ising critical point, are derived for operators involving one of the two matrices. It is shown that, within the space of the corresponding couplings, the resulting constraints obey a W(sub 3) algebra. DOE

N92-18387# International Centre for Theoretical Physics, Trieste (Italy).
HIGHER-SPIN AND W(SUB INFINITY)(J) ALGEBRAS IN VIRASORO-CONSTRAINED KP AND N-KdV HIERARCHIES
A. M. Semikhatov Feb. 1991 15 p
(DE92-603661; IC-91/44) Avail: NTIS HC/MF A03

Virasoro constraints on the KP hierarchy, arising in matrix models, are studied by re-expressing them in terms of dressing operators of the hierarchy. There exists a one-parameter family of Virasoro representations on the KP hierarchy (depending on a number J which can be identified as the conformal weight of an abstract bc system). The respective full invariance algebra is the 'Borel' subalgebra of W(sub infinity)(J), which we describe as an extension of the 'wedge', or higher spin, algebra B(sub lambda = J-J(exp 2)) by the L(sub 2) Virasoro generator. Reductions of these structures to the N-KdV hierarchies are performed explicitly. DOE

N92-18409# International Centre for Theoretical Physics, Trieste (Italy).
A DIFFERENTIAL EQUATION OF THE TRANSVERSE MOTION OF AN ISOTROPIC SANDWICH PLATE
Faxiang Zhang Aug. 1991 5 p
(DE92-603601; IC-91/219) Avail: NTIS HC/MF A01

A differential equation which describes the transverse motion of an isotropic sandwich plate undergoing free vibrations is derived. The derivation is based on small-deflection theory and several feasible assumptions are made for isotropic sandwich material. The method of superposing bending deflections and deflection due to transverse shear is used. DOE

N92-18410# International Centre for Theoretical Physics, Trieste (Italy).
THE INDEX OF A VECTOR FIELD UNDER BLOW UPS
J. Seade Aug. 1991 14 p
(DE92-603606; IC-91/239) Avail: NTIS HC/MF A03

A useful technique when studying the behavior of holomorphic vector fields around their isolated singularities is that of blowing up the singular points. On the other hand, the most basic invariant of a vector field with isolated singularities is its local index, as defined by Poincare and Hopf. It is thus natural to ask how does the index of a vector field behave under blowing ups? The purpose of this work is to study and answer this question, by taking a rather general point of view and bearing in mind that complex manifolds have a powerful birational invariant, the Todd genus. DOE

N92-18421# International Centre for Theoretical Physics, Trieste (Italy).
THE POLYAKOV PATH INTEGRAL OVER BORDERED SURFACES 3 (THE BRST EXTENDED CLOSED STRING OFF-SHELL AMPLITUDES)
Z. Jaskolski May 1991 43 p
(DE92-603672; IC-91/90) Avail: NTIS HC/MF A03

The geometrical approach to the functional integral over Faddeev-Popov ghost fields is developed and applied to construct the BRST extension of the off-shell closed string amplitudes in the constant curvature gauge. In this gauge the overlap path integral for off-shell amplitudes is evaluated. It leads to the nonlocal sewing procedure generating all off-shell amplitudes from the cubic interaction vertex. The general scheme of the reconstruction of a covariant closed string field theory from the off-shell amplitudes is discussed within the path integral framework. DOE

N92-18446# International Centre for Theoretical Physics, Trieste (Italy).
ON AN INNER PRODUCT OVER lmc *-ALGEBRAS
N. Mohammad and A. Verjovsky Aug. 1991 9 p
(DE92-603600; IC-91/218) Avail: NTIS HC/MF A02

An inner product is defined on a commutative *-semisimple separable Frechet Q lmc *-algebra A and the resultant space A(sub m) is shown to be a topological *-algebra. It is also proved that every maximal ideal M of A is A(sub m) -closed and thus A can be decomposed into A = M + M(sup perpendicular). Further, it is shown that a norm can be defined on A which makes it into a pre C(sup *) -algebra. A completeness criterion for A(sub m) is established. DOE

N92-18447# International Centre for Theoretical Physics, Trieste (Italy).
REMARKS ON THE E-INVARIANT AND THE CASSON INVARIANT
J. Seade Aug. 1991 11 p
(DE92-603603; IC-91/230) Avail: NTIS HC/MF A03

In this work a framed manifold means a pair (M,F) consisting of a closed C(sup infinity), stably parallelizable manifold M, together with a trivialization F of its stable tangent bundle. The purpose of this work is to understand and determine in higher dimensions the invariant h(M,F) appearing in connection with the Adams e-invariants. DOE

N92-18448# International Centre for Theoretical Physics, Trieste (Italy).
EXTENDING VALUATIONS IN DIVISION ALGEBRAS
M. MahdaviHezavehi Aug. 1991 6 p
(DE92-603604; IC-91/231) Avail: NTIS HC/MF A02

Let D be a finite dimensional F-central division algebra and v a (Krull) valuation on F. Denote by V the matrix valuation on F extending v. It is shown that the following statements are equivalent: (1) v extends to a valuation on D, (2) V defines a valuation on each K(sub rho), where K(sub rho) is the image of K under the regular matrix representation rho, and K is a finite dimensional F-division subalgebra with F is included in K is included in D, (3) v has a unique extension to each finite dimensional F-division subalgebra K with F is included in K is included in D. A generalization of the above result is also given in terms of matrix valuations. DOE

N92-18468# International Centre for Theoretical Physics, Trieste (Italy).
MULTIPLE SOLUTIONS TO THE DOUGLAS PROBLEM IN S(SUP n)
Min Ji Jan. 1991 9 p
(DE92-603593; IC-91/16) Avail: NTIS HC/MF A02

A smooth Jordan curve (Gamma) and a great circle (sigma) which are linked in S(exp 3) are shown to bound at least two minimal annuli in S(exp 3). And in S(sup n)(n greater than or equal to 3), the existence of at least two minimal annuli bounded by a smooth Jordan curve (Gamma) and a great circle (sigma) is proved, provided that sigma is disjoint from Gamma and intersects a least area surface spanning Gamma. DOE

N92-18470# International Centre for Theoretical Physics, Trieste (Italy).
P-COMMUTATIVE TOPOLOGICAL *-ALGEBRAS
N. Mohammad and A. B. Thaheem Jul. 1991 9 p
(DE92-603597; IC-91/199) Avail: NTIS HC/MF A02

If P(A) denotes the set of all continuous positive functionals on a unital complete lmc (*)-algebra and S(A) the extreme points of P(A), and if the spectrum of an element chi Epsilon A coincides with the set (f (chi): f Epsilon S A), then A is shown to be P-commutative. Moreover, if A is unital symmetric Frechet Q lmc (*)-algebra, then this spectral condition is, in fact, necessary. Also, an isomorphism theorem between symmetric Frechet P-commutative lmc (*)-algebras is established. DOE

N92-18471# International Centre for Theoretical Physics, Trieste (Italy).
ON THE LEFT IDEAL IN THE UNIVERSAL ENVELOPING ALGEBRA OF A LIE GROUP GENERATED BY A COMPLEX LIE SUBALGEBRA
J. Tirao Aug. 1991 12 p
(DE92-603602; IC-91/228) Avail: NTIS HC/MF A03

Let G(sub 0) be a connected Lie group with Lie algebra g(sub 0) and let h be a Lie subalgebra of the complexification g of g(sub 0). Let C(sup infinity) (G sub 0) (sup h) be the annihilator of h in C(sup infinity) (G sub 0) and let A = A(C sup infinity) (G sub 0) (sup h) be the annihilator of C(sup infinity) (G sub 0) (sup h) in the universal enveloping algebra U(g) of g. We discuss when A is equal to the left ideal of U(g) generated by h. In particular if G is a complexification of G(sub 0) and h is the Lie algebra of a closed connected subgroup H of G we establish that A(O(G)(sup h)) = U(g)h if and only if G/H has many holomorphic functions. This is the case if G/H is a quasi-affine variety. From this we get that if H is a unipotent subgroup of G or if G and H are reductive groups then A(C(sup infinity)) (G sub 0) (sup h) = U(g)h. DOE

N92-18499# General Electric Co., Schenectady, NY. Knolls Atomic Power Lab.
A VARIABLE TIMESTEP GENERALIZED RUNGE-KUTTA METHOD FOR THE NUMERICAL INTEGRATION OF THE SPACE-TIME DIFFUSION EQUATIONS
B. N. Aviles, T. M. Sutton, and D. J. Kelly, III Sep. 1991 15 p
Proposed for presentation at the ANS Topical Meeting on Advances in Reactor Physics, Charleston, SC,8-11 Mar. 1992
(Contract DE-AC12-76SN-00052)
(DE92-003010; KAPL-4731; CONF-920308-4) Avail: NTIS HC/MF A03

A generalized Runge-Kutta method has been employed in the numerical integration of the stiff space-time diffusion equations. The method is fourth-order accurate, using an embedded third-order solution to arrive at an estimate of the truncation error for automatic timestep control. The efficiency of the Runge-Kutta method is enhanced by a block-factorization technique that exploits the sparse structure of the matrix system resulting from the space and energy discretized form of the time-dependent neutron diffusion equations. Preliminary numerical evaluation using a one-dimensional finite difference code shows the sparse matrix implementation of the generalized Runge-Kutta method to be highly accurate and efficient when compared to an optimized iterative theta method. DOE

N92-18520# International Centre for Theoretical Physics, Trieste (Italy).
A NOTE ON WU WEN-TSUEN'S NON-DEGENERATE CONDITION
Zhang Jingzhong, Hou Xiaorong, and Yang Lu (Academia Sinica, Sichuan, China) Jul. 1991 10 p
(DE92-609041; IC-91/160) Avail: NTIS HC/MF A02

It is shown that Wu's non-degenerate condition which plays an important role in Wu's theory on algebraic system and automated theorem proving can be replaced with a much weaker one, so the characteristic-set-based method is extensively valid except for very few trivial instances. DOE

N92-18526# Oak Ridge National Lab., TN.
A CASE AGAINST A DIVIDE AND CONQUER APPROACH TO THE NONSYMMETRIC EIGENVALUE PROBLEM
E. R. Jessup Dec. 1991 28 p
(Contract DE-AC05-84OR-21400)
(DE92-004086; ORNL/TM-11903) Avail: NTIS HC/MF A03

Divide and conquer techniques based on rank-one updating have proven fast, accurate, and efficient in parallel for the real symmetric tridiagonal and unitary eigenvalue problems and for the bidiagonal singular value problem. Although the divide and conquer mechanism can also be adapted to the real nonsymmetric eigenproblem in a straightforward way, most of the desirable characteristics of the other algorithms are lost. In this paper, we examine the problems of accuracy and efficiency that can stand in the way of a nonsymmetric divide and conquer eigensolver based on low-rank updating. DOE

N92-18558# Argonne National Lab., IL.
ON IMPLICIT TAYLOR SERIES METHODS FOR STIFF ODES
G. Kirlinger (Technische Univ., Vienna, Austria) and G. F. Corliss 1991 10 p Presented at the SCAN '91 International Symposium on Computer Arithmetic and Scientific Computing, Oldenburg, Fed. Republic of Germany, 1-4 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-004720; ANL/CP-74795; CONF-9110300-1) Avail: NTIS HC/MF A02

Several versions of implicit Taylor series methods (ITSM) are presented and evaluated. Criteria for the approximate solution of ODEs via ITSM are given. Some ideas, motivations, and remarks on the inclusion of the solution of stiff ODEs are outlined. DOE

N92-18670# International Centre for Theoretical Physics, Trieste (Italy).
SEMILINEAR HYPERBOLIC SYSTEMS AND EQUATIONS WITH SINGULAR INITIAL DATA
T. Gramchev Jul. 1991 13 p
(DE92-603583; IC-90/267) Avail: NTIS HC/MF A03

We study the weak limits u(sup epsilon)(t,.) for epsilon approaches 0 of solutions to semilinear strictly hyperbolic systems and wave equations with initial data u(sup epsilon)(0,.) approximating a distribution kappa, 0 less than epsilon much less than 1. We propose an optimal link between the singularity of kappa and the growth of the nonlinear term in order that u(sup epsilon)(t,.) for epsilon approaches 0 exists. DOE

N92-18671# International Centre for Theoretical Physics, Trieste (Italy).
ON THE ADIABATIC INVARIANTS OF HAMILTONIAN SYSTEMS
N. A. Rustamov Dec. 1990 12 p
(DE92-603624; IC-90/412) Avail: NTIS HC/MF A03

The mathematical problem of the adiabatic invariants for the pendulum equation is discussed. The adiabatic invariant for the equation of the transverse vibration of a string is obtained. DOE

N92-18756# International Centre for Theoretical Physics, Trieste (Italy).
MODULI SPACE FOR ENDOMORPHISMS OF FINITE DIMENSION VECTOR SPACES
H. Kanarek Dec. 1990 6 p
(DE92-603589; IC-90/434) Avail: NTIS HC/MF A02

Consider the set (End(sub n)) of endomorphisms of vector spaces of dimension n less than infinity. There is no moduli space for (End(sub n)). What we present here is a decomposition of (End(sub n)) in which each element has a fine moduli space and one of them is composed by semisimple endomorphisms. DOE

N92-18796# International Centre for Theoretical Physics, Trieste (Italy).
PATH INTEGRAL ON NON-SIMPLY CONNECTED SPACE AND PROBLEM WITH ZERO BOUNDARY CONDITION
Hoang Ngoc Long Jul. 1991 9 p
(DE92-603626; IC-91/169) Avail: NTIS HC/MF A02

In this paper, a path integral formulation of various matrix elements of the evolution operator in a finite interval with zero boundary conditions is presented. Connection of these matrix elements with path integrals on a non-simply connected space is given as well. DOE

N92-18797# International Centre for Theoretical Physics, Trieste (Italy).
THE HAMILTONIAN STRUCTURES OF THE KP HIERARCHY
Ashok Das, Sudhakar Panda, and Wen-Jui Huang (Rochester Univ., NY.) Aug. 1991 11 p
(DE92-603628; IC-91/214; UR-1219; ER-13065-671) Avail: NTIS HC/MF A03

We obtain the two Hamiltonian structures of the KP hierarchy following the method of Drinfeld and Sokolov. We point out how the second structure of Drinfeld and Sokolov needs to be modified in the present case. We briefly comment on the connection between these structures and the W(sub 1 + infinity) algebra. DOE

N92-18808# International Centre for Theoretical Physics, Trieste (Italy).
HYBRID DEFORMED ALGEBRA U(SUB q-CIRCUMFLEX)sl(2) AS A GENERALIZATION TO QUANTUM ALGEBRA U(SB q)sl(2)
Hong Yan and Danping Peng (Beijing Univ., China) Jul. 1991 19 p
(DE92-603596; IC-91/198) Avail: NTIS HC/MF A03

The quantum algebra U(sub q)sl(2) is generalized by introducing a spin-dependent deformation parameter q-circumflex to replace q, the constant one. The representations are discussed with respect to whether q-circumflex takes the value of a root of unity or not. The quantum algebra U(sub q)sl(2) is recovered in a special case. The property of representation of this new algebra (denoted U(sub q-circumflex)sl(2)) is a mixture of those of U(sub q)sl(2) and Usl(2). DOE

N92-18815# International Centre for Theoretical Physics, Trieste (Italy).
AN INVARIANCE OF CDF EQUATION
Chou Tian May 1991 8 p Submitted for publication
(DE92-603617; IC-91/73) Avail: NTIS HC/MF A02

It is important, but difficult, to find the invariant groups for differential equations. We have found a new invariant group for the MKdV equation. In this paper, we present a new invariance for the CDF equation. By using this invariance, we obtain some new solutions for the CDF equation. DOE

N92-18821# New York Univ., New York. Inst. of Mathematical Sciences.
TECHNIQUES IN LINEAR AND NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS Final Report, 15 Apr. 1988 - 31 Jul. 1991
Louis Nirenberg 21 Oct. 1991 7 p
(Contract DAAL03-88-K-0047)
(AD-A244299; ARO-25069.11-MA) Avail: NTIS HC/MF A02
CSCL 12/1

The sliding method has been introduced, and the method of moving planes has been greatly extended and improved. These methods have been applied to a number of problems for fully nonlinear second order elliptic equations: (1) to treat symmetry and monotonicity of solutions in domains - even with nonsmooth boundaries; (2) to prove existence, uniqueness, and monotonicity of traveling waves in a cylinder, for problems arising in combustion theory and in biology, including extensions to higher dimension of work of Kolmogoroff, Petrovsky, and Piskounoff. Separate work studied flame propagation as a limit problem leading to a free boundary problem. Regularity of the free boundary has been studied by methods which should prove useful in other problems. Work on statistical mechanics and on deriving hydrodynamic scaling limit equation of Ginzburg-Landau was performed. A rigorous proof was given of the Euler equations for conservation laws from Hamiltonian systems. The question of existence of breathers and the existence of time-periodic solutions of hyperbolic equations on the line was studied. Nonexistence of certain solutions depending analytically on a parameter was shown. Formal solutions and various estimates were established. Variational methods have been used for nonlinear equations; heat flow methods have been used in the study of harmonic maps. GRA

N92-18842# International Centre for Theoretical Physics, Trieste (Italy).
A NEW REALIZATION OF BW ALGEBRA AND SOLUTIONS. YANG-BAXTER EQUATION
Lu-yu Wang, Jian-Hui Dai, and Jun Zhang May 1991 11 p
(DE92-603616; IC-91/61) Avail: NTIS HC/MF A03

Corresponding to a new braid group representation, a representation of Birman-Wenzl algebra is realized. The trigonometric type solutions of spectral-dependent Yang-Baxter equation are constructed in the framework of the Yang-Baxterization, and the related vertex models are also mentioned. DOE

N92-18862# Ohio State Univ., Columbus. Dept. of Engineering Mechanics.
LARGE DEFORMATION ANALYSIS OF NONLINEAR HOMOGENEOUS AND HETEROGENEOUS MEDIA USING AN ARBITRARY LAGRANGIAN-EULERIAN FINITE ELEMENT METHOD Final Report, 15 Mar. - 15 Mar. 1991
Somnath Ghosh 12 Nov. 1991 45 p Prepared in cooperation with Alabama Univ., Tuscaloosa
(Contract DAAL03-91-G-0069)
(AD-A244400; ARO-28317.1-EG) Avail: NTIS HC/MF A03 CSCL 12/1

In this paper, a new finite element formulation has been developed for media in which the second phase particulates or unidirectional fibers are randomly dispersed in a matrix. Deficiencies of the conventional mesh generators can be overcome by discretizing the domain using the method of Dirichlet tessellation. This method generates convex polygons known as Voronoi polygons which are treated as elements in a finite element analysis. An assumed stress hybrid method has been used to formulate the element stiffness matrix. Effect of the second phase has been incorporated in each element using a self-consistent type method. Several numerical examples have been conducted to validate the effectiveness of the model. GRA

N92-18903# Naval Postgraduate School, Monterey, CA. Dept. of Computer Science.
A LIBRARY OF FAILURE REGIONS Progress Report, Oct. 1990 - Sep. 1991
Timothy J. Shimeall 6 Sep. 1991 98 p
(AD-A244201; NPS-CS-91-002) Avail: NTIS HC/MF A05 CSCL 12/5

A failure region is the set of all possible program inputs that will execute a specific fault and produce a result that varies from the specified or expected program result. The purpose of this report is to document a set of failure regions corresponding to the known faults in a set of redundant program versions. Each failure region is characterized in two ways: by identifying the fault that it reveals and by identifying the boolean conditions necessary and sufficient to consider a program input to be a member of the failure region. Other reports describe the region analysis technique and profile the regions detailed here. GRA

N92-18922*# Michigan Univ., Ann Arbor. Radiation Lab.
MODELING OF RESISTIVE SHEETS IN FINITE ELEMENT SOLUTIONS Technical Report, Sep. 1991 - Feb. 1992
J. M. Jin, John L. Volakis, C. L. Yu, and A. C. Woo (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, CA.) 18 Feb. 1992 17 p
(Grant NAG2-541)
(NASA-CR-189955; NAS 1.26:189955; UMICH-025921-27-T)
Avail: NTIS HC/MF A03 CSCL 12A

A formulation is presented for modeling a resistive card in the context of the finite element method. The appropriate variational function is derived and for validation purposes, results are presented for the scattering by a metal-backed cavity loaded with a resistive card. Author

N92-18923*# Michigan Univ., Ann Arbor. Radiation Lab.
PROGRESS ON HYBRID FINITE ELEMENT METHODS FOR SCATTERING BY BODIES OF REVOLUTION Technical Report, Sep. 1991 - Feb. 1992
Jeffery D. Collins and John L. Volakis Feb. 1992 20 p
(Grant NAG2-541)
(NASA-CR-189954; NAS 1.26:189954; UMICH-025921-26-T)
Avail: NTIS HC/MF A03 CSCL 12A

Progress on the development and implementation of hybrid finite element methods for scattering by bodies of revolution are described. It was found that earlier finite element-boundary integral formulations suffered from convergence difficulties when applied to large and thin bodies of revolution. An alternative implementation is described where the finite element method is terminated with an absorbing termination boundary. In addition, an alternative finite element-boundary integral implementation is discussed for improving the convergence of the original code. Author

N92-18924*# Michigan Univ., Ann Arbor. Radiation Lab.
ALTERNATIVE FIELD REPRESENTATIONS AND INTEGRAL EQUATIONS FOR MODELING INHOMOGENEOUS DIELECTRICS Technical Report, Sep. 1991 - Feb. 1992
John L. Volakis Feb. 1992 15 p
(Grant NAG2-541)
(NASA-CR-189953; NAS 1.26:189953; UMICH-025921-25-T)
Avail: NTIS HC/MF A03 CSCL 12A

New volume and volume-surface integral equations are presented for modeling inhomogeneous dielectric regions. The presented integral equations result in more efficient numerical implementations and should, therefore, be useful in a variety of electromagnetic applications. Author

N92-18943# Air Force Inst. of Tech., Wright-Patterson AFB, OH. School of Engineering.
APPLICATION OF MIXED H2/H INFINITY OPTIMIZATION M.S. Thesis
John J. Kusnierek Nov. 1991 135 p
(AD-A243895; AFIT/GAE/ENY/91D-18) Avail: NTIS HC/MF A07 CSCL 12/3

A non-conservative optimization technique is utilized to examine the problem of minimizing the 2 norm of one transfer function subject to an infinity-norm bound on another transfer function. For single exogenous input/single exogenous output systems, this non conservative mixed solution is shown to be up to 5 percent better in a specific example. For single exogenous input/two exogenous output systems, the mixed solution is shown to be up to 27 percent better than a previous technique for a specific example. Finally, a two exogenous input/two exogenous output practical system is examined to demonstrate the utility of this mixed optimization technique. GRA

65 STATISTICS AND PROBABILITY

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

N92-18032# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
GENERALIZED FIELD QUANTIZATION AND THE PAULI PRINCIPLE
A. B. Govorkov 1990 25 p Presented at the 5th International Conference on Hadronic Mechanics and Nonpotential Interactions, 13-17 Aug. 1990
(DE92-609100; JINR-E-2-90-364) Avail: NTIS HC/MF A03

The work is an attempt to prove that the generalized Pauli principle (i.e., Fermi statistics) for the half-integer spin fields and that the Bose statistics for the integer spin fields, with allowance for the existence of internal gauge symmetries, are consequences of more general assumptions of the local quantum field theory. DOE

N92-18408# International Centre for Theoretical Physics, Trieste (Italy).
AN EXTENSION OF BROSOWSKI-MEINARDUS THEOREM ON INVARIANT APPROXIMATION
Liaqat Ali Khan and Abdul Rahim kahn Jul. 1991 7 p
(DE92-603594; IC-91/175) Avail: NTIS HC/MF A02

We obtain a generalization of a fixed point theorem of Dotson for non-expansive mappings on star-shaped sets and then use it to prove a unified Brosowski-Meinardus theorem on invariant approximation in the setting of p-normed linear spaces. DOE

N92-18531# International Centre for Theoretical Physics, Trieste (Italy).
ORDER IN THE TURBULENT PHASE OF GLOBALLY COUPLED MAPS
G. Perez, S. Sinha, and H. A. Cerdeira Apr. 1991 28 p
(DE92-603750; IC-91/66) Avail: NTIS HC/MF A03

The very surprising broad peaks seen in the power spectra of the mean field in a globally coupled map system, indicating subtle coherences between the elements even in the 'turbulent' phase, are investigated in detail with respect to number of elements coupled, nonlinearity, and global coupling strength. We find that the peaks are determined by two distinct components: effective renormalization of the nonlinearity parameter in the local mapping and the strength of the mean field iteration term. We also demonstrate the influence of background noise on the peaks - which is quite counterintuitive as the peaks become sharper with increase in strength of noise, up to a certain critical noise strength. DOE

N92-18570# Oak Ridge National Lab., TN.
DISCRETE PEARSON DISTRIBUTIONS
K. O. Bowman, L. R. Shenton (Georgia Univ., Athens.), and M. A. Kastenbaum Nov. 1991 26 p
(Contract DE-AC05-84OR-21400)
(DE92-004700; ORNL/TM-11899) Avail: NTIS HC/MF A03

These distributions are generated by a first order recursive scheme which equates the ratio of successive probabilities to the ratio of two corresponding quadratics. The use of a linearized form of this model will produce equations in the unknowns matched by an appropriate set of moments (assumed to exist). Given the moments, we may find valid solutions. There are two cases: (1) distributions defined on the non-negative integers (finite or infinite); and (2) distributions defined on negative integers as well. For (1), given the first four moments, it is possible to set this up as equations of finite or infinite degree in the probability of a zero occurrence, with the sth component being a product of s ratios of linear forms in this probability in general. For (2), the equation for the zero probability is purely linear but may involve slowly converging series; here a particular case is the discrete normal. Regions of validity are being studied. DOE

N92-18698# Washington Univ., Seattle. Inst. for Nuclear Theory.
MODELS OF FRAGMENTATION PHENOMENA BASED ON THE SYMMETRIC GROUP S(SUB n) AND COMBINATIONAL ANALYSIS
A. Z. Mekjian and S. J. Lee (Rutgers Univ., Piscataway, NJ.) 29 Jan. 1991 41 p Prepared in cooperation with Rutgers Univ., Piscataway, NJ
(Contract DE-FG06-90ER-40561)
(DE92-004368; DOE/ER-40561/15) Avail: NTIS HC/MF A03

Various models for fragmentation phenomena were developed using methods from permutation groups and combinational analysis. The appearance and properties of power laws in these models are discussed. Various exactly soluble cases were studied. DOE

N92-18731# National Aerospace Lab., Amsterdam (Netherlands). Informatics Div.
SOME AEROSPACE APPLICATIONS OF ESTIMATION THEORY Ph.D. Thesis - Technische Univ.
G. Moek 31 Mar. 1991 185 p
(NLR-TP-91100-U; ETN-92-90972) Avail: NTIS HC/MF A09

The application of estimation theory to three problems from aerospace research is described. The applications considered deal with spacecraft attitude estimation, software reliability modeling and estimation, and with a satellite based navigation algorithm. Maximum likelihood estimation is used in the software reliability case and mean square estimation in the other two applications. An adaptive iterated extended Kalman filter is evaluated on the basis of simulated and real spacecraft attitude measurement data. Results based on different combinations of attitude measurements and sensor models are compared. A satellite based navigation algorithm using a spline approximation of a vehicle trajectory and a recursive nonlinear least squares estimation algorithm are described. Application to simulated range measurements shows the potential for accurate position determination. Maximum likelihood parameter estimation for four software reliability models is analyzed. Conditions are derived pertaining to the existence of bounded solutions of the likelihood equations. Uniqueness of such solutions is proofed for two of the four models. Some results of the application to both simulated and real software failure time are given. ESA

N92-18822# Florida State Univ., Tallahassee. Dept. of Statistics.
ORDER STATISTICS AND OPTIMAL ALLOCATION PROBLEMS
Emad El-Neweihi and Jayaram Sethuraman Jul. 1991 10 p
(Contract DAAL03-90-G-0103)
(AD-A244301; FSU-TR-M-852; ARO-27868.9-MA; ARO-TR-D-120)
Avail: NTIS HC/MF A02 CSCL 12/3

Order statistics play an important role in reliability. The life time of any coherent system is the first order statistic of the, generally dependent, lives of its cut sets. For the important class of k-out-of-n systems, the lifetime of the system is the n - k + 1th order statistic of the lives of its components, which are often assumed to be independent. Therefore, the reliability of many systems can be easily stated as a probability concerning an order statistic. A system is called a second order r-out-of-k system if it is a r-out-of-k system based on k modules, without common components, and where each module is an a sub i out of n sub i system. Two features of such systems are of interest: the probability that a particular module is among the modules that failed before the failure of the system; and the number of failed components at the time of the failure of the system. In this paper, we review results regarding these features for some special cases of second order r-out-of-k systems, emphasizing their applications to optimal allocation problems. GRA

66 SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

N92-18207# Lawrence Livermore National Lab., CA.
INTERNATIONAL DEFENSES AGAINST BALLISTIC MISSILE ATTACK: NOW, MORE THAN EVER
L. Wood Mar. 1991 11 p Presented at the Defending America in the 1990s, Washington, DC, 20-21 Feb. 1991
(Contract W-7405-eng-48)
(DE92-003062; UCRL-JC-106720; CONF-9102142-1) Avail: NTIS HC/MF A03

This speech, made soon after Desert Storm, presents ideas on the threat of ballistic missiles to the United States. The availability of the missiles to third world countries is discussed. Strong support for the assigned mission of the Strategic Defense Initiative Organization known as Global Protection Against Limited Strikes (GPALS) is made. Also, implications to the ABM treaty are made. DOE

N92-18696# Los Alamos National Lab., NM.
SUPPRESSION OF SPACE-BASED INTERCEPTORS BY NEUTRAL PARTICLE BEAMS

G. H. Canavan Nov. 1991 15 p
(Contract W-7405-eng-36)
(DE92-004339; LA-11855-MS) Avail: NTIS HC/MF A03

Neutral particle beams (NPBs) popped up before missile launch could irradiate space-based interceptors (SBIs), suppressing those that could effectively attack the missiles. NPB effectiveness could be quite high against unshielded, undecoyed SBIs. The results are sensitive to launch radius, beam brightness, and SBI hardness. Even low brightness NPBs would be effective in suppressing the threats over compact launch areas. DOE

N92-18724# Los Alamos National Lab., NM.
APPROXIMATE AVERAGE DEPLOYMENTS VERSUS DEFENSE PARAMETERS
G. H. Canavan Dec. 1991 7 p
(Contract W-7405-eng-36)
(DE92-004751; LA-11880-MS) Avail: NTIS HC/MF A02

Calculations of the number of reentry vehicles (RV's) killed as a function of missile and defense parameters can be well approximated by analytic expressions that are valid for all numbers of missiles and interceptors. The approximation uniformly underestimates the effectiveness of boost-phase defenses: the discrepancies in kill rates are about 10 percent. If it is used to size the boost phase of two-layer defenses, the uncertainties would at worst double the demands on the midcourse layer, which is generally a minor part of the total. DOE

N92-18857# Los Alamos National Lab., NM.
NATIONAL SECURITY USES OF SPACE: STATUS, PROSPECTS, AND ISSUES
J. C. Browne, P. J. Garrity, and G. H. Canavan Jan. 1992 15 p
(Contract W-7405-eng-36)
(DE92-005354; LA-11810-MS) Avail: NTIS HC/MF A03

National security uses of space have grown rapidly in the last two decades because only space platforms can perform certain vital missions. Currently, space-based systems are used for information communication, and early warning. The pressure for more, and more capable, space systems should grow as fast over the next two decades as it has in the last two in support of strategic deterrence, conventional military operations, and strategic defenses. DOE

67 THEORETICAL MATHEMATICS

Includes topology and number theory.

N92-18134# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
QUANTIZATION OF CONSTRAINED SYSTEMS AND PATH INTEGRAL IN CURVILINEAR SUPERCOORDINATES
S. V. Shabanov 1990 34 p Submitted for publication
(DE92-609054; JINR-E-2-90-25) Avail: NTIS HC/MF A03

For systems with constraints the question about a non-commutability of quantization and elimination of unphysical variables is studied in the framework of path integrals (PI). It is shown that one should take into consideration a curvilinear character of physical variables and their phase space reduction in order to provide a one-to-one correspondence between the Dirac scheme and PI description. The latter leads to a modification of the standard PI (PI with a gauge condition). A general recipe of a PI derivation is suggested for any method of picking out physical variables which corresponds to the Dirac scheme. DOE

N92-18449# International Centre for Theoretical Physics, Trieste (Italy).
EXAMPLE OF A NON-MEASURABLE SET INVOLVING APERIODIC TRAJECTORIES OF A DISCRETE MAP
K. W. Wojciechowski Feb. 1991 7 p
(DE92-603607; IC-91/24) Avail: NTIS HC/MF A02

We consider a discrete map transforming a compact set in R(sup N) onto itself. Under assumptions that: (1) there exists a measure on this set which is invariant under the map, and (2) the set of all cyclic trajectories has a measure which is strictly less than the measure of the whole set, it is shown that the set consisting of all 'distinct initial conditions' (each point of the set represents a different aperiodic trajectory of the discrete map) is non-measurable with respect to this measure. DOE

N92-18768# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DECOMPOSITION OF MAPPINGS BETWEEN COMPLETE LATTICES BY MATHEMATICAL MORPHOLOGY. PART 1: GENERAL LATTICES
Gerald Jean Francis Banon and Junior Barrera Nov. 1991 92 p Sponsored in cooperation with Coordenacao de Aperfeicoamento de Pessoal de Ensino Superior, Conselho Nacional de Desenvolvimento Cientifico e Tecnologico, Ecole Nationale Superieure des Mines, and Formation Internaitonale Aeronautique et Spatiale
(INPE-5346-NTC/300-Pt-1) Avail: NTIS HC/MF A05

Two canonical decompositions of mappings between complete lattices are presented. These decompositions are based on mathematical morphology elementary mappings: erosions, anti-erosions, dilations, and anti-dilations. The proposed decompositions are obtained by introducing the concept of morphological connection, that extends the notion of Galois connection. The definitions of sup-generating mapping, kernel, and basis within the framework of complete lattices are given. The decompositions are built by analyzing the kernel and may be simplified from the basis. The results are specialized to the cases of inf-separable, increasing, and decreasing mappings. The presented decompositions are dual. Some examples, including the case of Boolean functions simplification, illustrate the key concepts and the decomposition rule. Author

70 PHYSICS (GENERAL)

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics.*

N92-18092# Pennsylvania Univ., Philadelphia. Dept. of Electrical Engineering.
RADIATIVE INTERACTIONS WITH MICROMACHINED SURFACES: SPECTRAL POLARIZED EMITTANCE
J. N. Zemel 1991 12 p Presented at the Micro-Macro Studies of Multiphase Media, Argonne, IL, 9-11 May 1991
(Contract DE-FG02-88ER-13964)
(DE92-001742; DOE/ER-13964/3; CONF-9105275-1) Avail: NTIS HC/MF A03

The spectral, angular, polarized emittance (SAPE) is a simple means for observing the allowed electromagnetic energy states associated with periodic structures whose dimensions are comparable to the wavelength of the observed light. Other methods for measuring absorption are far more time consuming when a broad survey is of interest. An extensive body of SAPE data was obtained on 350-400 C intrinsic silicon lamellar gratings. Current approximations to the vector wave equation such as guided wave, modal, and Bloch wave methods provided insight into our experiments. A qualitative picture of the stationary electromagnetic states (SES) of lamellar gratings has been developed which agrees with experiment for a number of polarizations, and angular orientations of the emission k vector relative to the gratings. However, one type of emission does not fit any simple model we have examined and raises intriguing questions about emission from grating structures. A new, higher angular resolution emissometer (0.8 degrees instead of 5 degrees) has been completed. This system significantly increases the wavelength range from the current 3-14 micron range to 2-25 microns: a doubling of the spectral regime. The system is currently in a 'shakedown' mode. Preliminary data indicates that the new emissometer meets the design goals. DOE

N92-18144# Lawrence Livermore National Lab., CA.
MAGNETIC MEASUREMENTS AT LAWRENCE BERKELEY LABORATORY
M. I. Green, P. Barale, L. Callapp, M. Case-Fortier, D. Lerner, D. Nelson, R. Schermer, G. Skipper, D. VanDyke, and C. Cork et al Aug. 1991 4 p Presented at the 12th International Conference on Magnet Technology, Leningrad, USSR, 23-28 Jun. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004305; LBL-29973-Rev; CONF-910662-13-Rev) Avail: NTIS HC/MF A01

Recent magnetic measurement activities at LBL have been concentrated in two separate areas, electro-magnets and permanent magnets for the Advanced Light Source (ALS), and superconducting magnets for the Superconducting Super Collider Laboratory (SSCL). A survey of the many different measurement systems is presented. These include: AC magnetic measurements of an ALS booster dipole engineering model magnet, dipole moment measurements of permanent magnet blocks for ALS wigglers and undulators, permeability measurements of samples destined for wiggler and undulator poles, harmonic error analysis of SSC one meter model dipoles and quadrupoles and five meter long SSC prototype quadrupoles, harmonic error analysis of ALS dipoles, quadrupoles, and sextupoles, precision Hall probe mapping of ALS storage ring combined function magnets, and the design of the ALS insertion device magnets mapping system. We also describe a new UNIX based data acquisition system that is being developed for the SSC. Probes used for magnetic measurements include Helmholtz coils, integral coils, point coils, and bucking harmonic analysis coils, several different types of Hall probes, and nuclear magnetic resonance magnetometers. Both analog and digital integrators are used with the coils. Some problems that occurred and their rectification is described. The mechanisms used include rotating systems with optical encoders, X-Y mapping systems with optical encoders and a laser position measuring device. DOE

N92-18149# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
ON THE TREATMENT OF THE MICHELSON-MORLEY EXPERIMENT
V. N. Streltsov 1990 3 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE92-609076; JINR-R-2-90-337) Avail: NTIS HC/MF A01

It is noted that the introduction of Lorentz-Fitzgerald contraction for the explanation of a negative result of the Michelson-Morley experiment is associated with the inaccuracy of calculating the time of light propagation along a transverse arm of the interferometer. Systematic consideration of the influence of the earth's motion on the velocity of light propagation leads to the original Michelson result. It should be stressed that 'elongation formula' for a longitudinal arm is a consequence of the interpretation of this experiment from the viewpoint of the relativity theory. DOE

N92-18154# Fermi National Accelerator Lab., Batavia, IL.
END DESIGNS FOR SUPERCONDUCTING MAGNETS
R. C. Bossert, J. M. Cook, and J. S. Brandt Oct. 1991 15 p Presented at the Workshop on Physics at Fermilab in the 1990's, Breckenridge, CO, 15-24 Aug. 1989
(Contract DE-AC02-76CH-03000)
(DE92-003339; FNAL-TM-1757; CONF-890872-16) Avail: NTIS HC/MF A03

New accelerators such as the Tevatron Upgrade frequently require higher magnetic fields that have been conventionally used in superconducting magnets. Modern magnet designs often have a smaller bore diameter and wider cable than the early (e.g., Tevatron) superconducting coils and are consequently harder to wind. These developments make consideration of end winding more important. End parts must be made to confine the conductors to a consistent shape. This shape must be defined and described to both the parts manufacturers and those analyzing the magnetic field. Internal stresses in the cable must be minimized. It has therefore become necessary to reevaluate the methods used to determine the configuration of a magnetic end. This note describes those methods and attempts to apply them to possible cross sections for high field dipoles. The original Tevatron dipole end configuration is reviewed for reference. DOE

N92-18818# California Univ., San Diego, La Jolla. Inst. for Pure and Applied Physical Sciences.
LARGE MOTIONS OF THE MAGNETIZATION IN MAGNETICALLY ORDERED MEDIA Report, 1 Oct. 1990 - 30 Sep. 1991
Harry Suhl 30 Sep. 1991 3 p
(Contract N00014-89-J-1202)
(AD-A244288) Avail: NTIS HC/MF A01 CSCL 20/3

The two topics covered are: (1) Interaction of domain wall motion with elementary excitations, and the resulting damping and instability mechanisms. The limiting wall velocity is very nearly equal to the speed of the particular spin wave whose group and phase velocities are equal. When the driving field is large enough to induce this limiting velocity, the system achieves a fixed point, a state in which a group of nonsynchronous spin-waves is excited to a high, nonthermal level. (2) Self-organized criticality. Some further consolidation of this concept for large magnetic systems are achieved. Then, studies were begun to establish the minimum complexity a physical system must have if SOC behavior is to result. Even though the concept appears to be very successful in at least two well-defined areas (earthquake statistics, and large, magnetically ordered systems), the reasons are unclear. The simplest algorithms used in their description assume that the systems only get stuck in metastable states, but do not explain why. GRA

71 ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see *45 Environmental Pollution.*

N92-18050 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE AIRBORNE SOUND INSULATIONS OF METAL-FRAMED PARTITIONS
G. D. Plumb 1991 13 p
(BBC-RD-1991/10) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The sound insulation performances of several lightweight, metal-framed partitions were measured. The aim was to produce a design for a new type of partition which was cheaper than the 'Camden', which is currently used throughout the British Broadcasting Corporation (BBC), while maintaining a comparable sound insulation. As a result of the studies, a partition is recommended for use as an alternative to the Camden. It is provisionally named the 'Warren'. It is much cheaper to build than the Camden and should be more tolerant of poor building practices. It has comparable overall sound insulation properties to that of Camden, but its sound insulation curve is much smoother. Mineral wool in the cavities of the leaves of single or double leaf partitions appreciably increases the sound insulation properties. Adding extra layers of plaster board to single or double Warrens increases the mean sound insulation by an amount that is approximately equal to the increase that would be expected from the increase in mass. Adding mineral wool to these increased mass partitions had only a small effect on their sound insulation. Author

N92-18074 ESDU International Ltd., London (England).
PREDICTION OF FAR-FIELD HARMONIC NOISE FROM PROPELLERS Abstract Only
Nov. 1991 17 p
(ESDU-91033; ISBN-0-85679-795-2; ISSN-0307-0115) Avail: ESDU

A FORTRAN program for estimating the discrete frequency free-field noise from an isolated straight blade single propeller which is in uniform motion or stationary in a lossless atmosphere is given. Blade sweep is unlikely, however, to have a significant effect up to tip Mach numbers of 0.9. It is assumed that the

noise sources are compact chordwise so that they are line sources; that assumption excludes advanced propellers and prop fans. The input to the program is ambient static pressure and temperature, source/receiver relative geometry, propeller operating conditions, and blade geometry and lift coefficient at a number of radial stations. If the load distribution is not known, a default distribution is provided for which power supplied and propeller thrust generated is required. Predictions are compared with available limited data measured in a wind-tunnel, and a sketch shows a typical correlation. The program is provided on disc as ESDUpac 9133, and information is given on the format for the input and output, illustrated by two worked examples. A graphical method for the maximum harmonic levels from a static propeller is given in ESDU 76020. ESDU

N92-18214# Sheffield Univ. (England). Dept. of Control Engineering.
DESIGN OF ACTIVE NOISE CONTROL SYSTEMS OPERATING IN A THREE-DIMENSIONAL NONDISPERSIVE PROPAGATION MEDIUM
M. O. Tokhi and R. R. Leitch (Heriot-Watt Univ., Edinburgh, Scotland) May 1991 39 p
(RR-425; ETN-92-90647) Avail: NTIS HC/MF A03

A coherent method for the design of Active Noise Control (ANC) systems operating in a three dimensional non-dispersive propagation medium (acoustic free field) is presented. An analysis of the basic control structures is provided and conditions for the robust operation of such systems are determined. These conditions are interpreted as constraints on geometric compositions of the ANC systems. ESA

N92-18215# Sheffield Univ. (England). Dept. of Automatic Control and Systems Engineering.
THE ROBUST DESIGN OF ACTIVE NOISE CONTROL SYSTEMS BASED ON RELATIVE STABILITY MEASURES
M. O. Tokhi and R. R. Leitch (Heriot-Watt Univ., Edinburgh, Scotland) May 1991 43 p
(RR-426; ETN-92-90648) Avail: NTIS HC/MF A03

A design method for Active Noise Control (ANC) systems operating in a three dimensional nondispersive propagation medium is presented. The method is based on analysis of the relative stability of the inherent feedback loop. For practical systems, the use of absolute stability is not useful. A system having an extremely long oscillatory response is unlikely to be accepted and is liable to instability under small parameter variations. Practical limitations in the design of the controller, owing to the geometric configuration of the system are discussed. ESA

N92-18249 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE AIRBORNE SOUND INSULATIONS OF TIMBER-FRAMED PARTITIONS
G. D. Plumb 1991 22 p
(BBC-RD-1991/9) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

The sound insulation performances of several lightweight, timber framed partitions were measured. The purpose was to assess the merits of various sheet materials and the effects of changes in the construction details on the sound insulation performances of the partitions. The aim was to produce a design for a new type of partition which was cheaper than the conventional 'Camden', which is currently widely used in the BBC. As a result, a new design was tested and is recommended for use as a replacement for the Camden. It uses less material, is much cheaper to build, and should be more tolerant of poor building practices. Several recommendations are made on construction techniques, which apply whether the partition being built is a traditional Camden or the new design. Also, the use of fiberboard as a damping material for plasterboard is shown to improve the isolation of partitions greatly, much more than the consideration of its mass alone would lead one to expect. Author

N92-18251 British Broadcasting Corp., Kingswood (England). Engineering Div.
THE INTERACTION OF ACOUSTIC TREATMENT IN AN EXPERIMENTAL SOUND CONTROL ROOM
J. A. Fletcher 1991 16 p
(BBC-RD-1991/7) Copyright Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

In small studios or control rooms, the predicted reverberation time is often significantly different from that measured. The prediction is normally made from the absorption coefficients of the acoustic treatment and other materials as measured in a reverberation room. An experimental sound control cubicle was constructed in the Acoustic Test Room. The reverberation time was measured with many different combinations of acoustic treatment and the effective absorption coefficients of the items of acoustic treatment in different circumstances were determined. The results were compared with reverberation time prediction calculations. From these, some conclusions were drawn regarding the situations in which reverberation room measurements of absorption coefficient should be modified to give a more accurate prediction of reverberation time. Author

N92-18282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
AN EVALUATION OF SOME ALTERNATIVE APPROACHES FOR REDUCING FAN TONE NOISE
James H. Dittmar and Richard P. Woodward Feb. 1992 21 p
(NASA-TM-105356; E-6730; NAS 1.15:105356) Avail: NTIS HC/MF A03 CSCL 20A

The potential of two alternative approaches for reducing fan ton noise was investigated in this study. One of these approaches increases the number of rotor blades to shift the tone noise to higher frequencies that are not rated as strongly by the perceived noise scale. This alternative fan also would have a small number of long chord stator vanes which would reduce the stator response and lower rotor-stator interaction noise. Comparison of the conventional and alternative fan concepts showed that this alternative approach has as large or larger a perceived tone noise reduction potential as the conventional approach. The other alternative, a high Mach number inlet, is evaluated both for its noise attenuation and for its change in noise directivity. Author

N92-18776*# Pennsylvania State Univ., University Park. Dept. of Electrical and Computer Engineering.
A TWO DIMENSIONAL FINITE DIFFERENCE TIME DOMAIN ANALYSIS OF THE QUIET ZONE FIELDS OF AN ANECHOIC CHAMBER Final Report
Deirdre A. Ryan, Raymond J. Luebbers, Truong X. Nguyen (Research Triangle Inst., Hampton, VA.), Karl S. Kunz, and David J. Steich Jan. 1992 37 p
(Grant NAG1-1221)
(NASA-CR-189001; NAS 1.26:189001) Avail: NTIS HC/MF A03 CSCL 20A

Prediction of anechoic chamber performance is a difficult problem. Electromagnetic anechoic chambers exist for a wide range of frequencies but are typically very large when measured in wavelengths. Three dimensional finite difference time domain (FDTD) modeling of anechoic chambers is possible with current computers but at frequencies lower than most chamber design frequencies. However, two dimensional FDTD (2D-FTD) modeling enables much greater detail at higher frequencies and offers significant insight into compact anechoic chamber design and performance. A major subsystem of an anechoic chamber for which computational electromagnetic analyses exist is the reflector. First, an analysis of the quiet zone fields of a low frequency anechoic chamber produced by a uniform source and a reflector in two dimensions using the FDTD method is presented. The 2D-FDTD results are compared with results from a three dimensional corrected physical optics calculation and show good agreement. Next, a directional source is substituted for the uniform radiator. Finally, a two dimensional anechoic chamber geometry, including absorbing materials, is considered, and the 2D-FDTD results for these geometries appear reasonable. Author

72 ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

N92-18031# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
RELATIVISTIC NUCLEON
V. A. Belyakov and V. N. Streltsov 1990 7 p Submitted for publication
(DE92-609098; JINR-E-2-90-309) Avail: NTIS HC/MF A02

It is noted that the pion and vector meson fields of the relativistic nucleon behave in different ways. The contribution of the vector meson field increases with increasing energy and becomes dominating at gamma greater than or approx. = 10(exp 2) (gamma is the Lorentz factor). This leads to the growth of the transverse size for the nucleon. As a result, the character of peripheral and central collision changes (the former is determined by vector exchange). The cross section of rho and omega production increases. A significant contribution to the spin effect is expected. The opinion that the indicated growth of the transverse size of the nucleon leads to increasing the total cross section of nucleon interaction at high energy is expressed. DOE

N92-18040# EG and G Energy Measurements, Inc., Goleta, CA.
THE EFFECT OF CHARGE TRAPPING ON THE SPECTROMETRIC PERFORMANCE OF HgI2 GAMMA DETECTORS
J. S. Iwanczyk, W. F. Schnepple (XSIRIUS Scientific, Inc., Marina Del Ray, CA.), and M. J. Masterson 15 Oct. 1991 20 p Presented at the 7th International Workshop on Room Temperature-Semiconductor X ray and Gamma ray Detectors and Associated Electronics, Ravello, Italy, 23-28 Sep. 1991
(Contract DE-AC08-88NV-10617)
(DE92-003688; EGG-10617-2103; CONF-9109209-3) Avail: NTIS HC/MF A03

The paper presents a theoretical model to describe the charge collection process for HgI2 gamma detectors. The standard deviations of full energy peak distributions are shown as a function of mean drift lengths of electron and holes. Calculated spectra shape changes versus variation in the internal detector electrical field distribution are studied. Simulated spectra are compared with experimental data. The model assumptions and results are discussed. DOE

N92-18041# EG and G Energy Measurements, Inc., Los Alamos, NM.
A NEW RELATIVISTIC COLLISION RATE CALCULATION
G. Graham 19 Aug. 1991 47 p
(Contract DE-AC08-88NV-10617)
(DE92-003690; EGG-10617-5093; LAO-2732-2172) Avail: NTIS HC/MF A03

The collision rates that are used in RELFLAP, the relativistic fluid code for high-power microwave propagation through the atmosphere, are obtained from the first three moments of the relativistic Boltzmann collision integral. Expressions for the particle, momentum, and energy transfer rates caused by elastic, inelastic, and ionizing collisions were previously obtained by evaluating the moments of the relativistic Boltzmann collision integrals using a relativistic momentum distribution function and assuming scattering cross sections that are independent of the scattering angle. The resulting integral expressions are evaluated numerically over a two-dimensional grid of mean kinetic and thermal velocity in the code RELFCOL. The purpose of this memorandum is to document the calculation of new relativistic collision rates using angular dependent scattering cross sections. This new calculation is based on a similar nonrelativistic treatment given by Roussel-Dupre and on the earlier relativistic rate calculation. The earlier calculation was based on the incorrect assumption that the collision rates were proportional to the normalized mean electron momentum. This assumption yields unnaturally large collision rates for the extreme relativistic case. In fact, the rates for collisions between electrons and stationary neutral particles are proportional to the mean electron velocity. The new rate calculation is based on this fact. New derivations of the Boltzmann collision integrals, similar to the original derivations, are presented. Relativistic scattering cross sections are discussed. Expressions for the particle, momentum, and energy transfer rates were derived using differential scattering cross sections. Some of the computational methods used to calculate the collision rate and the results of the rate calculation are discussed. DOE

N92-18057# Washington Univ., Seattle. Inst. for Nuclear Theory.
SEGREGATION OF QUARKS WITHIN THE NEUTRON
Z. Dziembowski 1991 14 p
(Contract DE-FG06-90ER-40561)
(DE92-004386; DOE/ER-40561/31) Avail: NTIS HC/MF A03

Measurements of the nucleon form factor and structure function seem to indicate an inhomogeneous distribution of flavor, charge and spin within the nucleon. It is argued that the ordinary three-quark model with a spin-spin force of the type suggested by QCD can explain the inhomogeneity as seen at different resolutions. This agreement suggests a specific bound quark picture of the nucleon structure with a positive core of u and d quarks in a spin-O state of ms radius 0.17 (plus or minus) 0.01 fm(exp 2) and an outer layer of a linear size approximately 1 fm where the polarized u (in the proton) or d (in the neutron) is orbiting. DOE

N92-18058# Yale Univ., New Haven, CT.
MEDIUM ENERGY ELEMENTARY PARTICLE PHYSICS
1991 13 p
(Contract DE-FG02-86ER-40243)
(DE92-004413; DOE/ER-40243/8) Avail: NTIS HC/MF A03

This report discusses the following topics: muon beam development at LAMPF; muon physics; a new precision measurement of the muon g-2 value; measurement of the spin-dependent structure functions of the neutron and proton; and meson factories. DOE

N92-18066# Puerto Rico Univ., Rio Piedras. Dept. of Physics.
ON THE MEAN SPHERICAL APPROXIMATION FOR HARD IONS AND DIPOLES Summary Report
L. Blum, F. Vericat, and W. R. Fawcett (California Univ., Davis.) 9 Nov. 1991 18 p
(Contract N00014-90-J-1263)
(AD-A243271; TR-15) Avail: NTIS HC/MF A03 CSCL 20/5

The analytical solution of the Mean Spherical Approximation for the case of equal size ions and different size solvent is reexamined using only two parameters: a polarization parameter lambda and a screening parameter gamma. We show that the ion dipole cross energy parameter, which in previous work was obtained solving a cubic equation, can be obtained from a linear algebraic equation. Therefore, the inverse problem of calculating the reduced charge parameter d sub 0 and the reduced dipole parameter d sub 2 from lambda and gamma is reduced to a system of two equations: a cubic for d sub 0, and a linear for d sub 2. Simpler expressions for the thermodynamic parameters are also obtained. GRA

N92-18104# Cincinnati Univ., OH.
RESEARCH IN PARTICLE THEORY
F. Mansouri, P Suranyi, and L. C. R. Wijewardhana Oct. 1991 16 p
(Contract DE-FG02-84ER-40153)
(DE92-004070; DOE/ER-40153/8) Avail: NTIS HC/MF A03

In the test particle approximation, the scattering amplitude for two-particle scattering in (2 + 1)-dimensional Chern-Simons-Witten gravity and supergravity was computed and compared to the corresponding metric solutions. The formalism was then extended to the exact gauge theoretic treatment of the two-particle scattering problem and compared to 't Hooft's results from the metric approach. We have studied dynamical symmetry breaking in 2 + 1 dimensional field theories. We have analyzed strong extended technicolor (ETC) models where the ETC coupling is close to a critical value. There are effective scalar fields in each of the theories. We have worked on how such scalar particles can be

produced and how they decay. The phi(sup 4) field theory was investigated in the Schrodinger representation. The critical behavior was extracted in an arbitrary number of dimensions in second order of a systematic truncation approximation. The correlation exponent agrees with known values within a few percent. DOE

N92-18136# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
PRECRITICAL INCREASE OF PARTICLE COLLISION RATES
L. Muenchow 1990 9 p Submitted for publication
(DE92-609056; JINR-E-7-90-326) Avail: NTIS HC/MF A02

In quantum kinetics the collision integral follows from the imaginary part of the mass operator. Using this connection it is shown that the coupling of single particle motion to precritical density fluctuations causes a strong increase of the collision integral near the point of phase instability. DOE

N92-18142# California Univ., Berkeley. Lawrence Berkeley Lab.
ELECTROWEAK PHASE TRANSITIONS Ph.D. Thesis
G. W. Anderson 16 Sep. 1991 69 p
(Contract DE-AC03-76SF-00098)
(DE92-004177; LBL-31274; UCB-PTH-91/46) Avail: NTIS HC/MF A04

An analytic treatment of the one Higgs doublet, electroweak phase transition is given. The phase transition is first order, occurs by the nucleation of thin walled bubbles and completes at a temperature where the order parameter, (phi) sub T is significantly smaller than it is when the origin becomes absolutely unstable. The rate of anomalous baryon number violation is an exponentially function of (phi) sub T. In very minimal extensions of the standard model it is quite easy to increase (phi) sub T so that anomalous baryon number violation is suppressed after completion of the phase transition. Hence baryogenesis at the electroweak phase transition is tenable in minimal of the standard model. In some cases additional phase transitions are possible. For a light Higgs boson, when the top quark mass is sufficiently large, the state where the Higgs field has a vacuum expectation value (phi) = 246 GeV is not the true minimum of the Higgs potential. When this is the case, and when the top quark mass exceeds some critical value, thermal fluctuations in the early universe would have rendered the state (phi) = 246 GeV unstable. The requirement that the state (phi) = 246 GeV is sufficiently long lived constrains the masses of the Higgs boson and the top quark. Finally, we consider whether local phase transitions can be induced by heavy particles which act as seeds for deformations in the scalar field. DOE

N92-18237# Oregon Univ., Eugene.
SURFACE AND INTERFACE ELECTRONIC STRUCTURE Progress Report, 5th Year
S. D. Kevan 1991 5 p
(Contract DE-FG06-86ER-45275)
(DE92-004388; DOE/ER-45275/5) Avail: NTIS HC/MF A01

This report discusses: surface states and resonances on Ta(011); surface states and phonon anomalies on Pt(111); and surfaces fermi contours and charge transfer. DOE

N92-18265# Washington Univ., Seattle.
MEASURING STRANGENESS MATRIX ELEMENTS OF THE NUCLEON
E. M. Henley, S. J. Pollock, G. Krein, and A. G. Williams 1991 10 p
(Contract DE-FG06-90ER-40561)
(DE92-004374; DOE/ER-40561/21) Avail: NTIS HC/MF A02

Experiments are proposed to measure various strangeness matrix elements of the nucleon. Examples are electro- and neutrino-production of phi mesons and the difference between neutrino and antineutrino scattering from isospin zero targets, e.g., deuterons. DOE

N92-18275# Washington Univ., Seattle. Inst. for Nuclear Theory.
OLD AND NEW PHYSICS IN NUCLEON SPIN STRUCTURE
H. J. Lipkin (Weizmann Inst. of Science, Rehovoth, Israel) 1991 6 p
(Contract DE-FG06-90ER-40561)
(DE92-004385; DOE/ER-40561/30) Avail: NTIS HC/MF A02

EMC implies quarks carry very little of the proton spin. (G(sub A)/G(sub V))(sub n approaches p) implies that valence quarks carry 70 percent of the spin, but disagrees with SU(6). (G(sub A)/G(sub V))(sub Sigma(-) approaches n) agrees strinkingly with SU(6). All semileptonic decay data can be fit by SU(3), but no model fits the data by breaking SU(6) without also breaking SU(3). Considerable data on hadron masses and magnetic moments are fit by a simple constituent quark model with only constituent quarks. A toy model for the proton with valence quarks and sea fits nearly everything. DOE

N92-18285# University Coll. of Wales, Aberystwyth. Dept. of Physics.
VIBRATIONALLY EXCITED IONS: QUENCHING REACTION ENHANCEMENT, LIFETIMES Final Scientific Report
Lance Thomas 1991 53 p
(Grant AF-AFOSR-0122-88)
(AD-A241852; EOARD-TR-91-10) Avail: NTIS HC/MF A04
CSCL 07/4

During the study of vibrational relaxation of hydrogen halide ions it was observed that the proton transfer reactions of HBr with both CH4 and CO2 are endothermic. This shows that a recently proposed upward revision of the proton affinity scale in the 120-145 kcal/mol range is in error and indeed that the value of the proton affinity of CH4, P.A. (CH4) = 132 kcal/mol in the National Bureau of Standards (NBS) tables (which are currently the most widely used references on proton affinities and thermochemical data), is somewhat too large. In order to quantify the proton affinity differences among BR, CH4, and CO2, the dependences on temperatures of the rate coefficients for endothermic proton transfer from HBr(+) to CH4 and CO2 have been measured using a variable-temperature selected ion flow tube. The problem in determining values of proton affinity is in setting the absolute scale since most laboratory measurements yield only relative proton affinities, these usually being obtained from equilibrium constant measurements. GRA

N92-18288# Georgia Inst. of Tech., Atlanta. School of Physics.
NUCLEAR STRUCTURE FROM RADIOACTIVE DECAY
J. L. Wood 30 Sep. 1991 12 p
(Contract DE-FG05-87ER-40330)
(DE92-003673; DOE/ER-40330/50) Avail: NTIS HC/MF A03

This report discusses nuclear structure from radioactive decay of the following: Neutron-Deficient Iridium Isotopes; Neutron-Deficient Platinum Isotopes; Neutron-Deficient Gold Isotopes; Neutron-Deficient Mercury Isotopes; Neutron-Deficient Thallium Isotopes; Neutron-Deficient Lead Isotopes; Neutron-Deficient Samarium Isotopes; Neutron-Deficient Promethium Isotopes; Neutron-Deficient Neodymium Isotopes; and Neutron-Deficient Praseodymium Isotopes. Also discussed are Nuclear Systematics and Models. DOE

N92-18348# Bern Univ. (Switzerland). Inst. fuer Theoretische Physik.
CHIRAL PERTURBATION THEORY WITH NUCLEONS
U. G. Meissner Sep. 1991 40 p Prepared in cooperation with Washington Univ., Seattle, WA
(Contract DE-FG06-90ER-40561)
(DE92-004383; DOE/ER-40561/28) Avail: NTIS HC/MF A03

I review the constraints posed on the interactions of pions, nucleons, and photons by the spontaneously broken chiral symmetry of QCD. The framework to perform these calculations, chiral perturbation theory, is briefly discussed in the meson sector. The method is a simultaneous expansion of the Greens functions in powers of external moments and quark masses around the massless case, the chiral limit. To perform this expansion, use is

made of a phenomenological Lagrangian which encodes the Ward-identities and pertinent symmetries of QCD. The concept of chiral power counting is introduced. The main part of the lecture consists of describing how to include baryons (nucleons) and how the chiral structure is modified by the fact that the nucleon mass in the chiral limit does not vanish. Particular emphasis is put on working out applications to show the strengths and limitations of the methods. Some processes which are discussed are threshold photopion production, low-energy compton scattering off nucleons, pi(N) scattering, and the sigma-term. The implications of the broken chiral symmetry on the nuclear forces are briefly described. An alternative approach, in which the baryons are treated as very heavy fields, is touched upon. DOE

N92-18394# Dartmouth Coll., Hanover, NH. Dept. of Chemistry.
PHOTOEXCITED CHARGE PAIR ESCAPE AND RECOMBINATION
C. L. Braun 15 Nov. 1991 7 p
(Contract DE-FG02-86ER-13592)
(DE92-004030; DOE/ER-13592/6) Avail: NTIS HC/MF A02

We report photocurrent transients arising from the pulsed laser excitation of the dipolar first excited singlet state S(sub 1) of trans 4-dimethyl-amino-4'-nitrostilbene (DMANS) in toluene solution. The currents arise from rotational reorientation of DMANS dipoles with respect to the axis of an applied electric field. The method appears to offer a simple and general approach to the measurement of the change in dipole moment upon electronic excitation of a molecule. In another experiment, durene (1,2,4,5-tetramethylbenzene) dissolved in n-hexane was photo-ionized by 35 psec pulses at 266 nm. Transient absorption at 1064 nm arising chiefly from geminate electrons was detected and used to monitor the recombination of the electron-cation pairs produced by two-photon ionization. An excellent fit to the recombination kinetics was obtained by assuming that the distribution of initial electron-cation separations was of the form r(exp 2)EXP = r(exp 2)/(2L(exp 3))exp((-)r/L) with a mean radius 3L = 5.7 nm. DOE

N92-18492# International Centre for Theoretical Physics, Trieste (Italy).
IS THERE A UNIQUE CANDIDATE THEORY FOR A BOUND STATE MODEL OF ELECTROWEAK SYMMETRY BREAKING WITH LIGHT VECTORS AND HEAVY SCALARS?
H. Schlereth Jul. 1991 12 p
(DE92-604047; IC-91/196) Avail: NTIS HC/MF A03

We show that there is only one confining nonabelian gauge theory with fermions that has no Goldstone bosons, maximal mixing with CP-odd glue via the chiral anomaly in the pseudoscalar channel, and with only one isospin group. Because of the possibility that the scalar states are lifted above the vector states, it is the candidate theory for describing composite weak bosons. We discuss whether the lightest (isosinglet) vector mass can be consistently adjusted to zero in a lattice construction of the theory and find that the isotriplet vector mass may well reproduce the weak boson mass. Some phenomenological consequences and the existence of a cold dark matter candidate are mentioned. DOE

N92-18504# Melbourne Univ., Parkville (Australia). School of Physics.
A PARAMETRISATION SCHEME FOR EFFECTIVE INTERACTIONS
H. V. vonGeramb (Hamburg Univ., Germany, F.R.), K. Amos, and L. Berge 1991 21 p
(DE92-604036; UM-P-90/112) Avail: NTIS HC/MF A03

An algorithm is developed by which two nucleon effective interactions are constructed to fit on- and off-shell t- and/or g-matrix elements. The effective interaction is defined as plane wave matrix elements of local operators that may have explicit energy and medium dependencies. It comprises central, tensor, spin-orbit, quadratic spin-orbit, and angular momentum square operators, all with Yukawa form factors. As examples, the Paris and Bonn potentials are used to construct t-matrices for projection onto chosen forms of effective interactions. DOE

N92-18505# International Centre for Theoretical Physics, Trieste (Italy).
CONSTRAINTS ON MASSES AND COUPLING CONSTANTS OF HYPOTHETICAL BOSONS FROM g(SUB e)-2 AND g(SUB mu)-2
A. I. Studenikin Jun. 1991 10 p
(DE92-604046; IC-91/104) Avail: NTIS HC/MF A02

This paper re-examines the constraints on the hypothetical scalar, pseudoscalar, and axial vector boson masses m(sub B) (B = S(sup 0),P(sup 0),A(sup 0)) and on the values of alpha(sub Bl) = g(sub Bl)(exp 2)/4(pi) (where g(sub Bl) is the coupling constant of the boson B and a charged lepton l) from data on g(sub l)-2, l = e,mu. The obtained new constraints are based on the correct expressions for S(sup 0), P(sup 0), and A(sup 0) contributions to g(sub l)-2, and differ substantially from limits received earlier. DOE

N92-18522# International Centre for Theoretical Physics, Trieste (Italy).
THE HYDROGEN ATOM AS AN ANTENNA. RETARDED RADIATION FIELD AND SPONTANEOUS EMISSION
A. O. Barut and B. Blaive (Colorado Univ., Boulder.) May 1991 19 p
(DE92-603705; IC-91/85) Avail: NTIS HC/MF A03

We have evaluated explicitly from the current of the electron in a nonstationary superposition state the near and far potentials and fields, then the radiated flux, and with it, the rate of spontaneous emission with retardation. The Schroedinger current gives a power which is four times smaller than the observed rate of spontaneous emission because the spin degrees of freedom are not included. DOE

N92-18538# Sandia National Labs., Albuquerque, NM.
RADIAL DEPENDENCE OF SILICON KVV AND L(SUB 23)VV AUGER MATRIX ELEMENTS
D. R. Jennison and P. Weightman 1991 10 p Presented at the 38th National Symposium of the American Vacuum Society, Seattle, WA, 11-15 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-004216; SAND-91-2493C; CONF-911132-10) Avail: NTIS HC/MF A02

We present calculations which show the radial dependence of the KVV and L(sub 23)VV Auger matrix elements of silicon. We find greatly differing dependences, converging within (approximately) 1 a.u. of the nucleus in the case of the KVV, but not until (approximately) 4 a.u. in the case of the L(sub 23)VV, well beyond the bond midpoint of (approximately) 2.2 a.u. We also find quite different dependences for the various elements within a particular CVV transition. Because the local density of states (LDOS) is dependent on the radius of the sphere of integration, our results suggest that different CVV Auger processes on the same atom in fact probe different LDOS's, as do even different contributions within the same transition. (This effect is separate from the well-known matrix element property which weights angular-momentum components differently.) These results call into question both the single-site LDOS approximation when used in the interpretation of low-energy (less than 100 eV) Auger spectra, and the application to high-energy spectra of local densities of states obtained by integration over muffin-tin or Wigner-Seitz spheres which have a large radius compared to the region probed by the Auger process. DOE

N92-18539# Oak Ridge National Lab., TN.
RECOMBINATION OF HIGHLY CHARGED IONS WITH FREE ELECTRONS
A. Mueller, A. Frank, J. Haselbauer, G. Hofmann, J. Neumann, U. Pracht, E. Salzborn, S. Schennach, W. Spies, and M. Stenke et al 1991 11 p Presented at the 8th Topical Conference on Atomic

Processes in Plasmas, Portland, ME, 25-29 Aug. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004228; CONF-9108105-5) Avail: NTIS HC/MF A03

Recombination of highly charged ions and free electrons is studied in interacting-beams experiments. Besides direct recombination into bound states by radiative capture, a variety of resonant recombination phenomena is observed. Resonant recombination produces a highly excited, usually short lived electron-ion compound which can stabilize by the emission of photons and/or electrons. Depending on this emission, the final charge state of the ion can be one less than the parent charge state, but it can also be higher and thus a net single or multiple ionization of the ion is observed after the initial recombination. DOE

N92-18658# International Centre for Theoretical Physics, Trieste (Italy).
DYNAMICAL MODELS OF HADRONS BASED ON STRING MODEL AND BEHAVIOUR OF STRONGLY INTERACTING MATTER AT HIGH DENSITY
Ikuo Senda May 1991 40 p
(DE92-604035; IC-91/89) Avail: NTIS HC/MF A03

We propose dynamical models of hadrons, the nucleation model and the free-decay model, in which results of string model are used to represent interactions. The dynamical properties of hadrons, which are obtained by string model, are examined and their parameters are fitted by experimental data. The equilibrium properties of hadrons at high density are investigated by the nucleation model and we found a singular behavior at energy density 3 to approximately 5 GeV/fm(exp 3), where hadrons coalesce to create highly excited states. We argue that this singular behavior corresponds to the phase transition to quark-gluon plasma. The possibility to observe the production of high density strongly interacting matter at collider experiments are discussed using the free-decay model, which produces pion distributions as decay products of resonances. We show that our free-decay model recovers features of hadron distributions obtained in hadron collision experiments. Finally, the perspectives and extensions are discussed. DOE

N92-18680# International Centre for Theoretical Physics, Trieste (Italy).
MULTIPHOTON EFFECTS IN ELECTRON-ION SCATTERING: A LIMITATION OF THE CROSS-SECTION TREATMENT
H. TorresSilva, P. H. Sakanaka, and L. C. Braga Jul. 1991 17 p
(DE92-603855; IC-91/171) Avail: NTIS HC/MF A03

The differential cross section for inelastic scattering in the presence of an intense laser field, when applied to the calculation of energy balance and heating by multiphoton process, is a problem which is not completely solved yet. One of the main difficulties is the calculation of the absorption coefficients for a monoenergetic beam of electrons scattered by a static potential. There are contradictory results shown by different authors. Here we have derived absorption coefficient starting under the framework of quantum mechanics and then making the classical correspondence (h yields 0) according to the kinetic theory, and show that the absorption coefficient is always positive for all values of the particle incoming velocity, v vector sub i. Furthermore, we show that in the calculation ofthe absorption coefficient, we recover the Coulomb logarithm term. DOE

N92-18709# Kansas State Univ., Manhattan.
ATOMIC PHYSICS WITH HIGHLY CHARGED IONS
P. Richard Aug. 1991 104 p
(Contract DE-FG02-86ER-13491)
(DE92-004028; DOE/ER-13491/508) Avail: NTIS HC/MF A06

This report discusses: one electron outer shell processes in fast ion-atom collisions; role of electron-electron interaction in two-electron processes; multi-electron processes at low energy; multi-electron processes at high energy; inner shell processes; molecular fragmentation studies; theory; and, JRM laboratory operations. DOE

N92-18710# Missouri Univ., Columbia.
A STUDY OF POTENTIAL HIGH BAND-GAP PHOTOVOLTAIC MATERIALS FOR A TWO STEP PHOTON INTERMEDIATE TECHNIQUE IN FISSION ENERGY CONVERSION
16 Aug. 1991 33 p
(Contract DE-FG02-91ER-12107)
(DE92-004046; DOE/ER-12107/1) Avail: NTIS HC/MF A03

A diamond synthesis chamber and an ion implanter have been constructed. Work has been rapidly progressing and a diamond has been synthesized. There are five variables which affect the quality of diamond: (1) mass flow of methane; (2) mass flow of hydrogen; (3) filament temperature; (4) substrate temperature; and (5) substrate material. Enclosed are pictures and data of previous diamond growth experiments. Current work is focused on the conditions which produce the best quality diamond films. In this study, diamond films were deposited using a hot-filament CVD method with boron trioxide (B2O3) and diphosphorus pentoxide (P2O5) as the doping sources. P2O5 is the only known effective phosphorus source for forming n-type semiconducting material. An RF generator has been made operation for epitaxial growth of AlN by the chemical vapor deposition method. In initial experiments with a graphite substrate, the RF generator heated the material to a temperature of 1100 C. A reactor which will use the RF generator has been built for AlN synthesis. The device should be assembled and tested by the end of August. A new process for fabricating platinum silicide photovoltaic cells has been developed. A diffused guard ring has been added to minimize leakage current. VUV to near IR capability has been developed for optical characterization. A microwave driven excimer lamp has been built and tested. Our previous work used a microwave source on an electron cyclotron heated ion source. DOE

N92-18714# New Mexico State Univ., Las Cruces.
EXPERIMENTAL STUDIES OF PION-NUCLEUS INTERACTIONS AT INTERMEDIATE ENERGIES
31 Dec. 1991 34 p
(Contract DE-FG04-88ER-40403)
(DE92-004819; DOE/ER-40403/T3) Avail: NTIS HC/MF A03

This report summarizes the work on experimental research in intermediate energy nuclear physics carried out at New Mexico State University in 1991 under a grant from the U.S. Department of Energy. Most of these studies have involved investigations of various pion-nucleus interactions. The work has been carried out both with the LAMPF accelerator at the Los Alamos National Laboratory and with the cyclotron at the Paul Scherrer Institute (PSI) near Zurich, Switzerland. Part of the experimental work involves measurements of new data on double-charge-exchange scattering, using facilities at LAMPF which we helped modify, and on pion absorption, using a new detector system at PSI that covers nearly the full solid-angle region which we helped construct. Other work involved preparation for future experiments using polarized nuclear targets and a new high-resolution spectrometer system for detecting pi(sup 0) mesons. We also presented several proposals for works to be done in future years, involving studies related to pi-mesonic atoms; fundamental pion-nucleon interactions; studies of the difference between charged and neutral pion interactions with the nucleon; studies of the isospin structure of pion-nucleus interactions; and pion scattering from polarized HE-3 targets. This work is aimed at improving our understanding of the pion-nucleon interaction, of the pion-nucleus interaction mechanism, and of nuclear structure. DOE

N92-18715# Drexel Univ., Philadelphia, PA. Dept. of Physics.
NON-ACCELERATOR PARTICLE PHYSICS
R. I. Steinberg and C. E. Lane Aug. 1991 92 p
(Contract DE-AC02-86ER-40257)
(DE92-004833; DOE/ER-40257/6) Avail: NTIS HC/MF A05

The goals of this research were the experimental testing of fundamental theories of physics such as grand unification and the exploration of cosmic phenomena through the techniques of particle physics. We have worked on the MACRO experiment, which is employing a large area underground detector to search for grand

unification magnetic monopoles and dark matter candidates and to study cosmic ray muons as well as low and high energy neutrinos. The nu IMB project, which seeks to refurbish and upgrade the IMB water Cerenkov detector to perform an improved proton decay search together with a long baseline reactor neutrino oscillation experiments using a one kiloton liquid scintillator (the Perry experiment), is addressed. The development of technology for improved liquid scintillators and for very low background materials in support of the MACRO and Perry experiments and for new solar neutrino experiments is also covered. DOE

N92-18771# Texas Univ., Austin. Dept. of Physics.
INVESTIGATION OF PION-NUCLEUS INTERACTIONS
C. F. Moore Sep. 1991 34 p
(Contract DE-FG05-87ER-40343)
(DE92-004061; DOE/ER-40343/5) Avail: NTIS HC/MF A03

The double isovector giant state has been observed in the pi(-), pi(+) Delta T(sub z) = +2 double-charge-exchange reaction on C-13, Al-27, Ca-40, Fe-56, Co-59, and Nb-93. The resonances observed in the pi(-), pi(+) reaction are closely related via Coulomb displacement energy and isospin symmetry to the resonances measured in the inverse pi(+), pi(-) reaction on the same nuclei. The new observations provide a direct determination of the upper isospin component of the double giant dipole state, which is generally very weak in the pi(+), pi(-) reaction. The comparison between the double dipole in the two double-charge-exchange modes gives valuable information on the isospin splitting and the Pauli-blocking effects for isotensor transitions. DOE

N92-18805# California Univ., Berkeley. Lawrence Berkeley Lab.
PHOTOELECTRON AND PHOTODISSOCIATION STUDIES OF FREE ATOMS AND MOLECULES, USING SYNCHROTRON RADIATION Ph.D. Thesis
L. J. Medhurst Nov. 1991 138 p
(Contract DE-AC03-76SF-00098)
(DE92-004001; LBL-31466) Avail: NTIS HC/MF A07

High resolution synchrotron radiation and Zero Kinetic Energy Photoelectron spectroscopy were used to study two-electron transitions in atomic systems at their ionization thresholds. Using this same technique the core-ionized mainline and satellite states of N2 and CO were studied with vibrational resolution. Vibrationally resolved synchrotron radiation was used to study the dissociation of N2, C2H4, and CH3Cl near the N 1s and C 1s thresholds. The photoelectron satellites of the argon 3s, krypton 4s, and xenon 4d subshells were studied with zero kinetic energy photoelectron spectroscopy at their ionization thresholds. In all of these cases, satellites with lower binding energies are enhanced at their thresholds while those closer to the double ionization threshold are suppressed relative to their intensities at high incident light energies. DOE

N92-18807# Notre Dame Univ., IN.
THEORETICAL STUDIES IN NUCLEAR STRUCTURE
E. R. Marshalek Nov. 1991 10 p
(Contract DE-FG02-91ER-40640)
(DE92-004025; DOE/ER-40640/1) Avail: NTIS HC/MF A02

In this period, the work has centered on two topics. The first is the study of a novel type of collective rotation in which an atomic nucleus with an inversion-symmetric shape rotates uniformly about an axis that is not a principal axis of the quadrupole tensor of the density distribution. This mode is referred to as tilted rotation. By using the cranking model together with higher-order corrections, it was shown that tilted rotation is indeed possible, not only within a microscopic framework, but also within the framework of collective models such as the IBM. The maximum tilt angle of pi/4 is realized for a certain class of states in the U(5) limit. The second topic, which actually was suggested during the course of the first investigation, is concerned with a new way of representing collective harmonic-oscillator algebras using boson-mapping techniques. In this approach, the many-phonon eigenvectors of a 2(lambda)+1-dimensional oscillator having good angular momentum are represented by simple products of boson operators acting on a vacuum. This representation may simplify the calculation of reduced matrix elements of arbitrary operators in collective models, but more work needs to be done. DOE

N92-18846# Temple Univ., Philadelphia, PA. Dept. of Physics.
EXPERIMENTAL INVESTIGATIONS IN PARTICLE PHYSICS AT INTERMEDIATE ENERGIES
L. B. Auerbach, V. L. Highland, C. J. Martoff, K. W. McFarlane, C. Guss, and S. Kettell 30 Sep. 1991 18 p
(Contract DE-FG02-88ER-40389)
(DE92-005081; DOE/ER-40389/71) Avail: NTIS HC/MF A03

The major elements of this project continues to be on fundamental symmetries and parameters of the Standard Model. The projects in the current period have been BNL E791 (a search for the decay K(sub L)(sup 0) yields micro-e, which would violate the rule of separate lepton number conservation), test of an upgrade proposal (E871), and LSND, a neutrino experiment at LAMPF. For E791, data taking was completed in June 1990, and preliminary results are now available for the decays K(sub L)(sup 0) yields micro-e and K(sub L)(sup 0) yields (mu)(mu)from the entire data set. The data for decay K(sub L)(sup 0) yields ee are still being analyzed. These are an upper limit for the branching fraction for K(sub L)(sup 0) yields micro-e of 3.5 x 10(exp -11) (90 pct. C.L.). From the 1990 data alone, we have a new (preliminary) value of the branching fraction for K(sub L)(sup 0) yields (mu)(mu) of (6.96 + or - 0. 4 + or - 0.22) x 10(exp -9), with a sample of 349 events. Combining this with earlier data gives (6.96 + or - 0.34) x 10(exp 9), by far the most precise value. The limit on the decay K(sub L)(sup 0) yields micro-e places a lower limit on the mass of a new particle mediating such decays of 85 TeV. The LSND (Large Scintillator Neutrino Detector), a search for neutrino oscillations at LAMPF, has been approved, and is now underway. Other neutrino work at Los Alamos, E764, has resulted in a final publication. This includes the best measurement of (nu)-nuclear scattering, in (nu)(sub mu) C-12 inclusive cross sections. The measurement of the cross section for the exclusive reaction (nu)(sup mu)(C-12) yields (mu)(sup -12) N is unique. In a new development, Dr. Martoff has established a facility for fabrication of superconducting detectors of nuclear radiation; the equipment has been funded and is partly installed. Planned uses include scattering for 'Dark Matter.' In summary, the objectives for this year have been met. DOE

N92-18863# Washington Univ., Seattle.
SOME MEASUREMENTS FOR DETERMINING STRANGENESS MATRIX ELEMENTS IN THE NUCLEON
E. M. Henley, S. J. Pollock, S. Ying, T. Frederico (Centro Tecnico Aerospacial, San Jose dos Campos, Brazil), and G. Krein 1991 6 p Presented at the 13th European Conference on Few-Body Problems in Physics, Elba, Italy, 9-14 Sep. 1991
(Contract DE-FG06-88ER-40427)
(DE92-004272; DOE/ER-40427/24-N91; CONF-9109122-5)
Avail: NTIS HC/MF A02

Some experiments to measure strangeness matrix elements of the proton are proposed. Two of these suggestions are described in some detail, namely electro-production of phi mesons and the difference between neutrino and antineutrino scattering for isospin zero targets such as deuterium. DOE

N92-18864# Illinois Univ., Chicago.
PRELIMINARY MEASUREMENTS OF SHADOWING AT VERY LOW X(SUB Bj)
D. E. Jaffe 1991 14 p Presented at the Moriond Meeting on High Energy Hadronic Interactions, Les Arcs, France, 17-23 Mar. 1991
(Contract DE-AC02-76ER-02289)
(DE92-004289; CONF-9103119-4) Avail: NTIS HC/MF A03

The ratio of cross sections for deeply inelastic muon scattering on xenon and deuterium nuclei was measured at very low X(sub Bj) (.00002 less than X(sub Bj) less than .25) for .01 less than Q(sup 2) less than 60 (GeV/c)(exp 2). The data were taken at Fermilab experiment E665 with an average muon beam energy of 490 GeV incident on 1.1 meter long deuterium and xenon target

vessels. Two largely independent analysis techniques gave statistically consistent results and show a smooth decrease in the ratio of the xenon-to-deuterium per-nucleon cross sections from (approximately) 1 to approx. 0.7 as X(sub Bj) decreases from approx. 0.1 to approx. 0.002. In the X(sub Bj) range 0.00002 to 0.002, the ratio remains roughly constant at approx. 0.7. DOE

N92-18889# Melbourne Univ., Parkville (Australia). School of Physics.
QUARK MASS THRESHOLDS IN QUARKONIUM SYSTEMS
R. M. Gorman and B. H. J. McKellar 1991 26 p
(DE92-604037; UM-P-91/43) Avail: NTIS HC/MF A03

This paper examines the role of quark mass thresholds in quarkonium systems, which are formed by the binding of heavy quark-antiquark pairs and are manifested in the psi and tau families of mesons. Such systems provide a probe of the interactions of quarks in a region accessible to the predictions of perturbative quantum chromodynamics (QCD) as well as in the long range region where the interaction is expected to show confining behavior consistent with the current knowledge of light quark systems. A prescription for deriving an interaction linking these two limits has been developed by Buchmuller, Grunberg and Tye (1980, 1981) and has been successfully applied to the psi and tau systems. This formalism has been extended by incorporating the effects of allowing the virtual quarks which contribute to the interaction to have finite masses. These masses must be considered energy dependent, and it is found that while the properties of psi and tau states are insensitive to the detailed way in which the masses vary, the presence of mass threshold has the effect of weakening the ability of this model to set the values for the QCD scale parameter, with 500 MeV becoming an approximate lower bound. DOE

N92-18890# International Centre for Theoretical Physics, Trieste (Italy).
A NEW SUPERFLUID PHASE IN ATOMIC NUCLEI
O. Dumitrescu Apr. 1991 77 p
(DE92-604071; IC-91/72) Avail: NTIS HC/MF A05

Influence of pairing and dynamical alpha-type correlations on the structure of nuclear states is studied within the enlarged superfluid model (ESM). Comparison between ESM and different modern nuclear structure models such as the quasiparticle-phonon nuclear model, interaction boson model, Hartree-Fock-Bogoliubov, temperature dependent Hartree-Fock-Bogoliubov, and Migdal's finite Fermi system model, is done for particular cases. New gap equations are obtained. The phase structure is enriched by a new superfluid phase, the so-called alpha-like superfluid phase, dominated by alpha-type correlations. New first and second order phase transitions are predicted. A first order phase transition between the alpha-like superfluid phase and the pairing superfluid phase seems to be observed in Sm region. New types of isomers, the 'superfluid isomers', with their bands of elementary excitations are predicted. One of them is observed in Sm-152. These isomers correspond to a second (local) minimum of the correlation energy vs. pairing deformations, analogous to the fission or superdeformed (shape) isomers, which correspond to the second (local) minimum of the potential energy along the elongation degree of shape deformation. The superfluidities of neutron and proton systems in a heavy nuclei region may be generated by one another. This explains the origin of odd-even staggering of the charged radii of chains of isotopes of different nuclei. The fact that the magnitude of the alpha-decay reduced widths (gamma(exp 2)) of the neutron-defficient Pb isotopes is almost equal to the gamma(exp 2) of the actinide alpha-decaying nuclei is due to the above-mentioned induction of the neutron superfluidity into the proton system also. Such exotic data ESM can explain especially in the region of single magic nuclei. Within ESM we could find a natural microscopic description of the scissors mode that dominates the structure of the K(exp pi) = 1(+) magnetic states. DOE

N92-18892# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
REGISTRATION EFFICIENCY OF THE HYPERON SPECTROMETER IN EXPERIMENTS ON INCLUSIVE PRODUCTION OF STRANGE PSEUDOSCALAR AND VECTOR MESONS
V. B. Vinogradov, L. Litov, S. Tokar, Yu. A. Kulchitskij, and M. N. Sergeenko (Akademiya Nauk BSSR, Minsk.) 1990 16 p In RUSSIAN; ENGLISH summary
(DE92-601497; JINR-R-10-90-230) Avail: NTIS HC/MF A03

The methodics and results of the registration efficiency determination for the HYPERON spectrometer in experiments on inclusive production of pseudoscalar and vector mesons in hadron-hadron and hadron-nucleus reactions are described. The calculate the acceptance the important-sampling method is used. The efficiency of the track detectors is found and with the help of the K(+) yields pi(+)pi(+)pi(-) decay the trigger efficiency of the spectrometer is obtained. The registration-efficiency values obtained are used in deriving the differential cross-sections of the processes K(+) + A yields K(sup 0) + X and K(+) + A yields K(sup *0)(892) + X. DOE

N92-18900# Washington State Univ., Pullman. Dept. of Chemistry.
STATISTICS OF FLUORESCENT PHOTONS EMITTED NEAR A PHASE CONJUGATOR
Henk F. Arnoldus, Thomas F. George, and Chung I. Um Jan. 1992 22 p
(Grant NSF CHE-90-16789)
(AD-A244186; WSU/DC/91/TR-71) Avail: NTIS HC/MF A03
CSCL 20/5

Temporal photon correlations and photon count statistics of fluorescence radiation, emitted by an atom in the vicinity of a phase conjugator, are considered. The fluorescent intensity and the two-photon correlation function are expressed in terms of photon emission operators. An explicit evaluation shows their dependence on the phase-conjugate reflectivity of the surface. The variance of the photon count distribution for long counting times is expressed in terms of the Q-factor, which is evaluated as a function of the reflectivity. It appears that for a reflectivity larger than unity, the photon correlation displays antibunching and the statistics are sub-poissonian. GRA

N92-18960# Rutherford High Energy Lab., Chilton (England).
RAPPORTEUR TALKS AT SINGAPORE (DEEP INELASTIC SCATTERING) AND AT HADRON 90 (CONFERENCE SUMMARY)
F. E. Close (Oak Ridge National Lab., TN.) Nov. 1990 24 p
(RAL-90-087; ETN-92-91051) Avail: NTIS HC/MF A03

The results of deep inelastic scattering investigations from the 1960's up to now are reviewed. The history and the future development of machines allowing the study of deep inelastic scattering processes are summarized. The analysis includes data on structure functions, polarized structure functions, possible violation of the Gottfried sum rule, and breakdown of perturbative Quantum Chromodynamics (QCD). Concerning hadrons, the most significant results of investigations on mesons are summarized. Scalar mesons' production from gamma-gamma collisions is underlined. Major questions dealing with the 0(-) and 1(-) mesons are reviewed. The application of perturbative QCD to exclusive channels at low Q to the 2nd power is stressed. For individual titles, see N92-18961 through N92-18962.

N92-18961# Rutherford High Energy Lab., Chilton (England).
DEEP INELASTIC SCATTERING
F. E. Close (Oak Ridge National Lab., TN.) *In its* Rapporteur Talks at Singapore (Deep Inelastic Scattering) and at Hadron 90 (Conference Summary) Nov. 1990 14 p (For primary document see N92-18960 09-72)
Avail: NTIS HC/MF A03

The early years of deep inelastic scattering are reviewed with particular reference to Bjorken's theoretical work. Progress in polarized inelastic scattering studies is underlined. The flavor

dependence is discussed. Current highlights include an agreed uniform set of structure functions, polarized structure functions, possible violations of the Gottfried sum rule, deep inelastic scattering of nuclei, and anticipated breakdown of naive perturbative quantum chromodynamics as x approaches zero at HERA. ESA

N92-18962# Rutherford High Energy Lab., Chilton (England).
CONFERENCE SUMMARY: HADRON 90
F. E. Close (Oak Ridge National Lab., TN.) *In its* Rapporteur Talks at Singapore (Deep Inelastic Scattering) and at Hadron 90 (Conference Summary) Nov. 1990 7 p (For primary document see N92-18960 09-72)
Avail: NTIS HC/MF A03

The most important results of investigations and models concerning mesons are summarized. The data on 0(+) mesons, the 2(+) states, and the gamma-gamma coupling are stressed. The positronium or quarkonium decay to gamma-gamma is illustrated. The production of scalar mesons from gamma-gamma collisions is discussed. Pseudoscalar and vector meson studies are considered. The application of perturbative quantum chromodynamics to exclusive channels at low Q to the 2nd power is overviewed. ESA

73 NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory.

For space radiation see *93 Space Radiation.*

N92-18028# Fermi National Accelerator Lab., Batavia, IL.
LONGITUDINAL BEAM DYNAMICS AT TRANSITION CROSSING
S. A. Bogacz Nov. 1991 10 p Presented at the 5th International Committee for Future Accelerators (ICFA) Beam Dynamics Workshop, Corpus Christi, TX, 3-8 Oct. 1991
(Contract DE-AC02-76CH-03000)
(DE92-004122; FNAL/C-91/300; CONF-9110243-6) Avail: NTIS HC/MF A02

A brief outline of the longitudinal single particle dynamics at transition is presented in terms of phase-space mappings. Simple quantitative prediction about the phase-space dilution is made. More realistic simulation (ESME) of the transition crossing is carried out (including various collective and single particle effects contributing to the longitudinal emittance blow up). The simulation takes into account the longitudinal space-charge force (bunch length oscillation), the transverse space-charge (the Umstaetter effect), and the dispersion of the momentum compaction factor (the Johnsen effect). As a result of this simulation, one can separate relative strengths of the above mechanisms and study their individual effects on the longitudinal phase-space evolution, especially filamentation of the bunch and formation of a 'galaxy-like' pattern. DOE

N92-18085# Superconducting Super Collider Lab., Dallas, TX.
PHASE-CONTROL SCHEME FOR SYNCHRONOUS BEAM TRANSFER FROM THE LOW ENERGY BOOSTER TO THE MEDIUM ENERGY BOOSTER
L. K. Mestha Sep. 1991 41 p
(Contract DE-AC35-89ER-40486)
(DE92-004112; SSCL-340) Avail: NTIS HC/MF A03

This report discusses the design philosophy of the new synchronization scheme for beam transfer from the Low Energy Booster (LEB) to the Medium Energy Booster at the Superconducting Super Collider. The fundamental principle of controlling the LEB acceleration is discussed. A generalized mathematical model is derived to facilitate the design of multiple feedback loops to control the synchronizing phase and the radial position of the beam. Applications of state feedback, sliding-mode, and model reference controllers are discussed. Although the state feedback controller is easy to design and implement, the simulation results show that the controller properties are not useful to handle disturbance due to field errors and variation in the system parameters. The sliding-mode and model reference controllers are shown to have more suitable properties. At the end, mention of the hardware used to establish the 'proof-of-principle' is given. DOE

N92-18106# Stanford Linear Accelerator Center, CA.
OBSERVATION AND ANALYSIS OF OSCILLATIONS IN LINEAR ACCELERATORS
J. T. Seeman Nov. 1991 22 p Presented at the US Particle Accelerator School, Upton, NY, 24 Jul. - 4 Aug. 1989
(Contract DE-AC03-76SF-00515)
(DE92-004715; SLAC-PUB-5294; CONF-890786-4) Avail: NTIS HC/MF A03

This report discusses the following linear accelerator topics: Betatron Oscillations; Betatron Oscillations at High Currents; Transverse Profile Oscillations; Transverse Profile Oscillations at High Currents; Oscillation and Profile Transient Jitter; and Feedback on Transverse Oscillations. DOE

N92-18137# Argonne National Lab., Idaho Falls, ID.
UNIVERSITIES AND NATIONAL LABORATORY ROLES IN NUCLEAR ENGINEERING
J. I. Sackett 1991 4 p Presented at the Winter Meeting of the ANS, San Francisco, CA, 10-15 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-001912; ANL/CP-73778; CONF-911107-35) Avail: NTIS HC/MF A01

Nuclear Engineering Education is being significantly challenged in the United States. The decline in enrollment generally and the reduction of the number of nuclear engineering departments has been well documented. These declines parallel a lack of new construction for nuclear power plants and a decline in research and development to support new plant design. Precisely at a time when innovation is needed to deal with many issues facing nuclear power, the number of qualified people to do so is being reduced. It is important that the University and National Laboratory Communities cooperate to address these issues. The Universities must increasingly identify challenges facing nuclear power that demand innovative solutions and pursue them. To be drawn into the technology the best students must see a future, a need and identify challenges that they can meet. The University community can provide that vision with help from the National Laboratories. It has been a major goal within the reactor development program at Argonne National Laboratory to establish the kind of program that can help accomplish this. DOE

N92-18179# Argonne National Lab., IL.
A STRIPLINE FAST FARADAY CUP FOR MEASURING GHz STRUCTURE OF ION BEAMS Patent Application
J. M. Bogaty, inventor (to DOE) 3 Jul. 1990 18 p
(Contract W-31-109-eng-38)
(DE92-003819; US-Patent-Appl-SN-547748;
Patents-US-A7547748) Avail: NTIS HC/MF A03

The Stripline Fast Faraday Cup is a device which is used to quantitatively and qualitatively measure gigahertz time structure characteristics of ion beams with energies up to at least 30 MeV per nucleon. A stripline geometry is employed in conjunction with an electrostatic screen and a Faraday cup to provide for analysis of the structural characteristics of an ion beam. The stripline geometry allows for a large reduction in the size of the instrument while the electrostatic screen permits measurements of the properties associated with low speed ion beams. DOE

N92-18220# Swedish Inst. of Space Physics, Umea.
CONVECTION OF ION CYCLOTRON WAVES TO ION HEATING REGIONS
Kjell Roennmark and Mats Andre (Umea Univ., Sweden) 26 Mar. 1991 16 p Sponsored in part by Swedish National Science Research Council
(IRF-Preprint-118; ETN-92-90663) Avail: NTIS HC/MF A03

Low frequency waves associated with ion conics are observed

in the central plasma sheet. Ion cyclotron waves generated in the equatorial plane by proton temperature anisotropy are studied. Computed growth rates are used to create a model wave distribution. Using ray tracing and conservation of the wave distribution function along phase space rays, the wave intensities from the equatorial plane to the top of the ion heating region are mapped. The spectral density at a geocentric distance of 2.8 RE is about 20 times higher than that in the equatorial region. Convection from the equatorial plane could thus explain the observed spectral density and the associated oxygen ion heating. ESA

N92-18289# Sandia National Labs., Albuquerque, NM.
PHASE MIXING OF TRANSVERSE OSCILLATIONS IN THE LINEAR AND NONLINEAR REGIMES FOR IFR RELATIVISTIC ELECTRON BEAM PROPAGATION
I. R. Shokair 1991 6 p Presented at the Charged Particle Beam Conference, Silver Springs, MD, 25-27 Jun. 1991
(Contract DE-AC04-76DP-00789)
(DE92-003956; SAND-91-2587C; CONF-9106276-4) Avail: NTIS HC/MF A02

Phase mixing of transverse oscillations changes the nature of the ion hose instability from an absolute to a convective instability. The stronger the phase mixing, the faster an electron beam reaches equilibrium with the guiding ion channel. This is important for long distance propagation of relativistic electron beams where it is desired that transverse oscillations phase mix within a few betatron wavelengths of injection and subsequently an equilibrium is reached with no further beam emittance growth. In the linear regime phase mixing is well understood and results in asymptotic decay of transverse oscillations as 1/Z(exp 2) for a Gaussian beam and channel system, Z being the axial distance measured in betatron wavelengths. In the nonlinear regime (which is likely mode of propagation for long pulse beams) results of the spread mass model indicate that phase mixing is considerably weaker than in the regime. In this paper we consider this problem of phase mixing in the nonlinear regime. Results of the spread mass model will be shown along with a simple analysis of phase mixing for multiple oscillator models. Particle simulations also indicate that phase mixing is weaker in nonlinear regime than in the linear regime. These results will also be shown. DOE

N92-18393# Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.
VECTORIZATION OF GEANT FOR GENERIC DETECTOR RESEARCH AND EVENT SIMULATION
W. R. Martin, S. J. Wilderman, and R. C. Ball Mar. 1991 23 p
(Contract DE-AC02-89ER-40513)
(DE92-004023; DOE/ER-40513/1) Avail: NTIS HC/MF A03

The Monte Carlo method for particle transport simulation is an essential tool in both the design process and the analytical evaluation process for detectors in the current and coming generation of high energy physics (HEP) experiments. Currently, the GEANT Monte Carlo shower simulation code is the primary research tool being used in modeling all aspects of particle transport in HEP detectors. As with most Monte Carlo programs, the effectiveness and range of applicability of GEANT is limited primarily by the excessive run time required to provide statistically reliable results. Since the number of tracks which must be simulated, and hence the computational effort required, increase dramatically as higher energy events are modeled, the need for increased computational speed will become more urgent as the HEP community continues to explore physics at ever increasing energies. Part of this need may be met by efficient utilization of the existing capabilities of current vector supercomputers, such as the Cray YMP/48 and the IBM 3090. Using such resources effectively with Monte Carlo programs involves alteration of the program from a scalar history based algorithm to a vectorized event based algorithm. Results of a preliminary evaluation of the suitability of GEANT for adaptation to a fully vectorizable event based algorithm are presented here. DOE

N92-18406# Los Alamos National Lab., NM.
CRITICAL EXPERIMENTS AND REACTOR TESTING IN SUPPORT OF THE ROVER PROGRAM
R. R. Paternoster and W. L. Kirk 1991 10 p Presented at the AIAA/NASA/OAI Conference on Advanced Space Exploration Initiative (SEI) Technologies, Cleveland, OH, 3-4 Sep. 1991
(Contract W-7405-eng-36)
(DE92-002514; LA-UR-91-2434; CONF-9109226-22) Avail: NTIS HC/MF A02

The Los Alamos Critical Experiments Facility (LACEF) played a central role in the Rover design and development process. This paper illustrates the iterative nuclear design and development process used during the Rover space nuclear reactor propulsion program and reviews the role played by critical experiments performed at the LACEF. DOE

N92-18429 Department of the Navy, Washington, DC.
OPTICALLY POWERED CHARGED PARTICLE ACCELERATOR Patent
Larry D. Flesner, inventor (to Navy) 17 Sep. 1991 7 p Filed 28 Jun. 1990
(AD-D015110; US-Patent-5,049,753; US-Patent-Appl-SN-549885; US-Patent-Class-250-396) Avail: US Patent and Trademark Office CSCL 20/7

A charged particle control apparatus provides very high voltage particle beams. One or more photocell arrays provide bias voltages for beam accelerating stages. The arrays are made from a number of microfabricated photocells connected in series to produce a voltage output that is the sum of the voltages from the individual cells. Arrays of each stage are connected in series to produce a cumulative stage voltage that is applied to an accelerating electrode made part of the stage. Optical power illuminates the stages to generate desired voltage biases to the accelerating electrodes. A light source is used to excite the photocathode when this emission source is used. Electrons from the emission source are accelerated electrodes and are emitted from the chamber which is typically conjoined with other apparatus. By utilizing photocell arrays to generate beam current and accelerating biases, as well as a photocathode for providing a source of electrons, the apparatus of the invention is completely optically isolated thereby requiring no direct electrical connections to the apparatus even though multiple accelerating stages are used to facilitate the achievement of very high voltage particle beams. GRA

N92-18668# Oak Ridge National Lab., TN.
USE OF ENERGETIC ION BEAMS IN MATERIALS SYNTHESIS AND PROCESSING
B. R. Appleton 1991 7 p Presented at the International Conference on Evolution in Beam Applications, Takasaki, Japan, 5-8 Nov. 1991
(Contract DE-AC05-84OR-21400)
(DE92-003529; CONF-911154-1) Avail: NTIS HC/MF A02

A brief review of the use of energetic ion beams and related techniques for the synthesis, processing, and characterization of materials is presented. Selected opportunity areas are emphasized with examples, and references are provided for more extensive coverage. DOE

N92-18744# California Univ., Los Angeles.
HIGH RESOLUTION RAMAN SPECTROSCOPY OF COMPLEXES AND CLUSTERS IN MOLECULAR BEAMS
P. M. Felker 1991 40 p
(Contract DE-FG03-89ER-14066)
(DE92-004206; DOE/ER-14066/3) Avail: NTIS HC/MF A03

The DOE-sponsored project in this laboratory has two facets. The first is the development of methods of nonlinear Raman spectroscopy for application in studies of sparse samples. The second is the application of such methods to structural and dynamical studies of species in supersonic molecular beams. The progress we have made in both of these areas is described in this paper. The report is divided into five remaining sections. The first pertains to theoretical and experimental developments in Fourier transform stimulated emission spectroscopy and Fourier

transform hole-burning spectroscopy. The second deals with progress in the development of ionization-detected stimulated Raman spectroscopies (IDSRS). The third describes results from the application of IDSRS methods to studies of jet-cooled benzene clusters. The fourth describes IDSRS results from studies of hydrogen-bonded complexes containing phenols. The fifth relates to studies of carbazole-Ar(n) clusters. DOE

N92-18774# Argonne National Lab., IL. High Energy Physics Div.
REVIEW OF TOTAL CROSS SECTIONS AND FORWARD SCATTERING PARAMETERS AT ULTRA-HIGH ENERGIES
M. M. Block (Northwestern Univ., Evanston, IL.) and A. R. White Oct. 1991 18 p Presented at the 21st International Symposium on Multiparticle Dynamics, Wuhan, Peoples Republic of China, 23-27 Sep. 1991
(Contracts W-31-109-eng-38; DE-AC02-76ER-02289)
(DE92-004153; ANL-HEP-CP-91-95; CONF-9109221-1) Avail: NTIS HC/MF A03

We review the field of the elastic scattering of pp and (bar p)p at the ultra-high energies. The recent total cross section, sigma (sub tot), and rho-value results from the Fermilab Tevatron Collider experiments presented at the 4th 'Blois' Workshop on Elastic and Diffractive Scattering (Elba, Italy, in May, 1991), allow us a comprehensive overview of the field. DOE

N92-18871# California Univ., Los Angeles.
THEORETICAL AND EXPERIMENTAL INVESTIGATION OF ELECTRON BEAM ACCELERATION AND SUBMILLIMETER WAVE GENERATION IN CYCLOTRON RESONANT CAVITIES
Final Report, 15 Sep. 1987 - 14 Mar. 1991
N. C. Luhmann, Jr. and D. B. McDermott 20 Jun. 1991 15 p
(Contract DAAL03-87-K-0139)
(AD-A244389; ARO-24861.5-PH) Avail: NTIS HC/MF A03
CSCL 09/1

Many millimeter wave generation interactions have been under development. A prebunched high harmonic gyrotron has extended the power level of our previous high harmonic gyrotrons. Also, the instabilities in gyro traveling wave tube (TWT) amplifiers are now understood and methods have been formulated to stabilize them (multi severs). This work has led to the design of a very high power (500 kW) harmonic gyro-TWT using a conventional MIG, which we plan to build in the next few years. We have also been active in the development of an extremely high power millimeter wave source, the CARM: (1) we have designed and simulated a 300 MW, 17 GHz device for the next generation high gradient RF linac; (2) we actively participated in LLNL's 250 GHz CARM project; and (3) we are continuing to fabricate at UCLA a 400 kV, 10 MW proof of principle CARM, which will use Bragg reflectors for its requisite frequency selective cavity. We have advanced the state-of-the-art of Bragg reflectors by testing high mode purity Bragg reflectors. In addition, we have designed and are well into the construction of a very high power, wideband continuous tunability gyro backward wave oscillator (BWO) and a very efficient gyro-klystron amplifier. GRA

74 OPTICS

Includes light phenomena; and optical devices.
For lasers see *36 Lasers and Masers.*

N92-18011# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
LQG CONTROL OF A DEFORMABLE MIRROR ADAPTIVE OPTICS SYSTEM WITH TIME-DELAYED MEASUREMENTS
M.S. Thesis
David J. Anderson 13 Dec. 1991 384 p
(AD-A243623; AFIT/GE/ENG/91D-03) Avail: NTIS HC/MF A17
CSCL 20/6

This thesis proposes a linear quadratic Gaussian (LQG) control law for a ground-based deformable mirror adaptive optics system. The incoming image wavefront is distorted, primarily in phase, due to the turbulent effects of the earth's atmosphere. The adaptive optics system attempts to compensate for the distortion with a deformable mirror. A Hartman wavefront sensor measures the degree of distortion in the image wavefront. The measurements are input to a Kalman filter which estimates the system states. The state estimates are processed by a linear quadratic regulator which generates the appropriate control voltages to apply to the deformable mirror actuators. The dynamics model for the atmospheric phase distortion consists of 14 Zernike coefficient states; each modeled as a first-order linear time-invariant shaping filter driven by zero-mean white Gaussian noise. The dynamics of the deformable mirror are also model as 14 Zernike coefficients with first-order deterministic dynamics. A significant reduction in total wavefront phase distortion is achieved in the presence of time-delayed measurements. Wavefront sensor sampling rate is the major factor limiting system performance. The Multimode Simulation for Optimal Filter Evaluation (MSOFE) software is the performance evaluation tool of choice for this research.
Author (GRA)

N92-18055# National Academy of Sciences - National Research Council, Washington, DC.
MATHEMATICAL OPPORTUNITIES IN NONLINEAR OPTICS
1992 63 p Sponsored in cooperation with AFOSR, DOE, IBM, NSF, the National Security Agency, and ONR
Avail: NTIS HC/MF A04

The Board on Mathematical Sciences takes as one of its functions that of identifying areas of important or emerging research activity and focusing attention on them. The Board seeks to stimulate cross-disciplinary research between mathematical sciences and disciplines. This survey notes that on the technological side nonlinear optics is likely to revolutionize future telecommunications and computer technologies, while on the mathematical side it is an ideal subject for the applied mathematician, who is particularly well positioned to make major contributions. Topics covered include wave propagation and the nonlinear Schrodinger equation; soliton propagation in the optical fibers; nonlinear waveguides; four-wave mixing, phase conjunction, and beam cleanup; lasers; optical bistability, logic elements, and information storing patterns; and spatiotemporal complexity and turbulence in nonlinear optics. Author

N92-18168 Department of the Navy, Washington, DC.
EMBEDDED FIBER OPTIC BEAM DISPLACEMENT SENSOR
Patent
Roger M. Crane, inventor (to Navy) and Eugene C. Fischer, inventor (to Navy) 11 Jun. 1991 11 p Filed 31 Oct. 1988
(AD-D015135; US-Patent-5,023,845; US-Patent-Appl-SN-264734; US-Patent-Class-364-508) Avail: US Patent and Trademark Office CSCL 17/5

This document discloses a method and apparatus for the two dimensional measurement of displacements of sample materials using a photodetector grid array and optical fiber embedded in the test specimen. The system consists of a light source which is passed into one end of an optical fiber which has embedded a beam specimen, so that when the beam is placed in motion, the light traverses through the fiber and emerges from the opposite end where its projected image traces a pattern simulating that of the beam. In a preferred embodiment, the collimated exiting light is incident upon a light beam splitter which directs equal portions of the light toward a quadrant photovoltaic cell device and toward a charge couple device (CCD). The CCD is connected to an optoelectronic viewing device for initial calibration, display and monitoring. The photodetector array is connected to a translator/amplifier which increases the photocells' source currents and converts them to equivalent voltages for output to a digital data processing terminal. The processing terminal integrates all simultaneous measurements by vectorial resolution of the voltage related deflections' magnitude and direction. GRA

N92-18170 Department of the Navy, Washington, DC.
HIGH OPTICAL DENSITY MEASURING SPECTROMETER
Patent

Jeanne A. Welch, inventor (to Navy) 24 Sep. 1991 7 p Filed 29 Sep. 1989 Supersedes N90-19318 (28 - 12, p 1621)
(AD-D015156; US-Patent-5,050,991; US-Patent-Appl-SN-415740; US-Patent-Class-356-326) Avail: US Patent and Trademark Office CSCL 14/2

An apparatus is disclosed for measuring the spectra of a high optical density sample having substantially known optical properties. In a preferred embodiment, the apparatus comprises: a laser for producing a light beam; and Raman cell responsive to the light beam for generating a first light containing a plurality of preselected wavelength components; an optical system for directing the first light through the sample; a dispersion device for spatially separating the first light passed through the sample into its plurality of preselected wavelength components; a plurality of light detectors positioned to respectively receive the spatially-separated preselected components into a plurality of associated photocurrents having amplitudes respectively representative of the numbers of photons in the spatially-separated preselected wavelength components; and a photon counter for respectively converting the plurality of associated photocurrents into a plurality of photon counts corresponding to the transmittance of the sample at the respective preselected wavelength components of the first light passing through the sample. GRA

N92-18181# Chicago Univ., IL.
ELECTRON MICROSCOPE STUDIES
A. V. Crewe and O. H. Kapp 1 Jun. 1991 141 p
(Contract DE-FG02-86ER-60437)
(DE92-004693; DOE/ER-60437/6) Avail: NTIS HC/MF A07

This year our laboratory has continued to make progress in the design of electron-optical systems, in the study of structure-function relationships of large multi-subunit proteins, in the development of new image processing software and in achieving a workable sub-angstrom STEM. We present an algebraic approach to the symmetrical Einzel (unipotential) lens wherein we simplify the analysis by specifying a field shape that meets some preferred set of boundary or other conditions and then calculate the fields. In a second study we generalize this approach to study of three element electrostatic lenses of which the symmetrical Einzel lens is a particular form. The purpose is to develop a method for assisting in the design of a lens for a particular purpose. In our biological work we study a stable and functional dodecameric complex of globin chains from the hemoglobin of Lumbricus terrestris. This is a complex lacking the 'linker' subunit first imaged in this lab and required for maintenance of the native structure. In addition, we do a complete work-up on the hemoglobin of the marine polychaete Eudistylia vancouverii, demonstrating the presence of a hierarchy of globin complexes. We demonstrate stable field-emission in the sub-angstrom STEM and the preliminary alignment of the beam. We continue our exploration of a algorithms for alignment of sequences of protein and DNA. Our computer facilities now include four second generation RISC workstations and we continue to take increasing advantage of the floating-point and graphical performance of these devices. DOE

N92-18186 Department of the Navy, Washington, DC.
ULTRAVIOLET OPTICAL ISOLATOR UTILIZING THE KDP-ISOMORPHS Patent
James L. Dexter, inventor (to Navy), John F. Reintjes, Jr., inventor (to Navy), Joseph E. Landry, inventor (to Navy), and David G. Cooper, inventor (to Navy) 9 Jul. 1991 7 p Filed 17 Oct. 1990 Supersedes N91-26923 (29 - 18, p 3063)
(AD-D015153; US-Patent-5,029,953; US-Patent-Appl-SN-597847; US-Patent-Class-350-1.1) Avail: US Patent and Trademark Office CSCL 20/6

An ultraviolet optical isolater which utilizes a KDP-isomorph crystal as the optical element is disclosed. In a preferred embodiment, the ultraviolet optical isolator comprises: an input polarizer for linearly polarizing an input beam of ultraviolet light in a first plane of polarization; means for rotating the plane of polarization of the linearly polarized ultraviolet light from the input polarizer by substantially 45 degrees in a first direction; a Faraday rotator including an optical element made of a KDP-isomorph crystal in which the plane of polarization of the rotated linearly polarized ultraviolet light from the rotating means is rotated about an optical axis of the optical element, a plurality of permanent magnets sequentially coupled together with alternating polarities for developing a magnetic field along the optical axis of the optical element in order to cause the optical element to rotate the plane of polarization of the rotated linearly polarized ultraviolet light from the rotating means by substantially another 45 degrees in the first direction to a second plane of polarization substantially orthogonal to the first plane of polarization, and means for moving the optical element so that the optical element is always enclosed by the plurality of permanent magnets; and an output polarizer for outputting the ultraviolet light in the second plane of polarization. Author (GRA)

N92-18192 Department of the Navy, Washington, DC.
LONG WAVELENGTH INFRARED DETECTOR WITH HETEROJUNCTION Patent
Tak-Kin Chu, inventor (to Navy) 10 Sep. 1991 4 p Filed 22 Jan. 1991
(AD-D015132; US-Patent-5,047,622; US-Patent-Appl-SN-645960) Avail: US Patent and Trademark Office CSCL 17/5

An infrared radiation detector having a first semiconductor layer deposited on a substrate to form a diode junction with an overlay contact, is rendered more effective to detect long wavelength radiation by deposit of a second semiconductor layer between the first layer and the overlay contact in a heterojunction arrangement. The semiconductor materials are selected so as to separate radiation absorbing and electrical functions respectively performed within the two layers and to produce an enhanced output across the diode junction between the first layer and the overlay contact. Author (GRA)

N92-18303# National Aerospace Lab., Tokyo (Japan). Thermofluid Dynamics Div.
THE INFLUENCE COEFFICIENT MATRIX FOR SIZE MEASUREMENTS OF FINE PARTICLES BY POLARIZED SCATTERING INTENSITY PATTERN ANALYSIS [HENKO SANRAN KYODO PATAN KAISEKI NIYORU BISHO RYUSHIGUN NO RYUDO SOKUTEI NOTAMENO EIKYO KEISU GYORETSU]
Shigeru Hayashi Jun. 1989 15 p In JAPANESE
(NAL-TM-606; ISSN-0452-2982; JTN-92-80243) Avail: NTIS HC/MF A03

In the past, the diffraction method has been used to measure particle diameter. However, this method is ineffective when the particle size is of the same order as the light wavelength, due to the influence of polarization by scattering light. In such cases, polarized scattering intensity pattern analysis enables determination of the particle size because the intensity of the polarized element increases in accordance with the particle size. For this type measurement, the influence coefficient matrix, which relates the scattering light energy on each sensor and particle size, is used. This paper presents the influence coefficient matrix, which is solved by Mie scattering function program, for analysis on a personal computer. Author (NASDA)

N92-18306# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
CONICAL WAVEFRONTS IN OPTICS AND TOMOGRAPHY
L. M. Soroko 1990 7 p Submitted for publication
(DE92-611126; JINR-E-13-90-334) Avail: NTIS HC/MF A02

A wide range of techniques in which the information is transferred by conical (nonspherical and nonplanar) wave fronts is considered. This is the first summary of papers published in the field of mesooptics and optical tomography. The topics covered include: (1) phenomenology of the conical wavefronts; (2) axicons; (3) theory of the conical wavefronts; (4) gravitational lenses; (5) integral transforms in mesooptics; (6) mesooptical elements with ring response; (7) optical tomography and confocal scanning microsopes; (8) mesooptical autocollimators and interferometers for conical wavefronts; (9) aberrations in mesooptics; and (10) the history of mesooptics. DOE

N92-18382# International Centre for Theoretical Physics, Trieste (Italy).
INTRODUCTION TO OPTICAL FIBER SENSORS
S. Moukdad Jun. 1991 14 p
(DE92-611161; LAMP-91/5) Avail: NTIS HC/MF A03

Optical fiber sensors have many advantages over other types of sensors, for example: low weight, immunity from EMI, electrical isolation, chemical passivity, and high sensitivity. In this seminar, a brief explanation of the optical fiber sensors, their use, and their advantages are given. A description of the main optical fiber sensor components is presented. Principles of some kinds of optical fiber sensors are presented, and the principle of the fiber-optic rotation sensor and its realization are discussed in some details, as well as its main applications. DOE

N92-18389# Lawrence Livermore National Lab., CA.
FAST, INEXPENSIVE, DIFFRACTION LIMITED CYLINDRICAL MICROLENSES
J. J. Synder and P. Reichert Jul. 1991 6 p Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Meeting, San Diego, CA, 21-26 Jul. 1991
(Contract W-7405-eng-48)
(DE92-003972; UCRL-JC-107983; CONF-9107115-61) Avail: NTIS HC/MF A02

We have developed a technique for fabricating fast, well corrected cylindrical microlenses. With this technique we have made a number of different microlenses with dimensions and focal lengths in the range of few hundred microns, and diffraction limited numerical apertures as high as 0.9. The microlenses are specifically designed for applications where they can increase the radiance or otherwise enhance the optical characteristics of laser diode light. The fabrication method we use is versatile, and the microlenses produced this way would be inexpensive in production quantities. DOE

N92-18509# EG and G Rocky Flats, Inc., Golden, CO.
FIBER-OPTIC VOLTAGE SENSOR Patent Application
C. B. Wood, inventor (to DOE) 12 Jul. 1990 11 p
(Contract DE-AC04-76DP-03533)
(DE92-003823; US-Patent-Appl-SN-551834;
Patents-US-A7551834) Avail: NTIS HC/MF A03

A fiber-optic voltage sensor is described which includes a source of light, a reference fiber for receiving a known percentage of the light and an electrostrictive element having terminals across which is applied, and a voltage to be measured. The electrostrictive element is responsive to the applied voltage to assume an altered physical state. A measuring fiber also receives a known percentage of light from the light source and is secured about the electrostrictive element. The measuring fiber is provided with a cladding and exhibits an evanescent wave in the cladding. The measuring fiber has a known length which is altered when the electrostrictive element assumes its altered physical state. A differential sensor is provided which senses the intensity of light in both the reference fiber and the measuring fiber and provides an output indicative of the difference between the intensities. DOE

N92-18529# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
FIBER OPTIC DETECTOR Patent Application
Judy K. Partin, inventor (to DOE), Thomas E. Ward, inventor (to DOE), and Alan E. Grey, inventor (to DOE) 30 Apr. 1990 22 p
(Contract DE-AC07-76ID-01570)
(DE92-004609; US-Patent-Appl-SN-516590;
Patents-US-A7516590) Avail: NTIS HC/MF A03

This invention is comprised of a portable fiber optic detector that senses the presence of specific target chemicals by exchanging the target chemical for a fluorescently-tagged antigen that is bound to an antibody which is in turn attached to an optical fiber. Replacing the fluorescently-tagged antigen reduces the fluorescence so that a photon sensing detector records the reduced light level and activates an appropriate alarm or indicator. DOE

N92-18552# Los Alamos National Lab., NM.
VIDEO IMAGE POSITION DETERMINATION Patent Application
W. Christensen, inventor (to DOE), F. L. Anderson, inventor (to DOE), and B. L. Kortegaard, inventor (to DOE) 2 Apr. 1990 30 p
(Contract W-7405-eng-36)
(DE92-003834; US-Patent-Appl-SN-502959;
Patents-US-A7502959) Avail: NTIS HC/MF A03

The present invention generally relates to the control of video and optical information and, more specifically, to control systems utilizing video images to provide control. Accurate control of video images and laser beams is becoming increasingly important as the use of lasers for machine, medical, and experimental processes escalates. In AURORA, an installation at Los Alamos National Laboratory dedicated to laser fusion research, it is necessary to precisely control the path and angle of up to 96 laser beams. This invention is comprised of an optical beam position controller in which a video camera captures an image of the beam in its video frames, and conveys those images to a processing board which calculates the centroid coordinates for the image. The image coordinates are used by motor controllers and stepper motors to position the beam in a predetermined alignment. In one embodiment, system noise, used in conjunction with Bernoulli trials, yields higher resolution centroid coordinates. DOE

N92-18553# Los Alamos National Lab., NM.
FIBER OPTIC MOUNTED LASER DRIVEN FLYER PLATES Patent Application
D. L. Paisley, inventor (to DOE) 2 Apr. 1990 10 p
(Contract W-7405-eng-36)
(DE92-003835; US-Patent-Appl-SN-502960;
Patents-US-A7502960) Avail: NTIS HC/MF A02

This invention is comprised of a laser driven flyer plate where the flyer plate is deposited directly onto the squared end of an optical fiber. The plasma generated by a laser pulse drives the flyer plate toward a target. In another embodiment, a first metal layer is deposited onto the squared end of an optical fiber, followed by a layer of a dielectric material and a second metal layer. The laser pulse generates a plasma in the first metal layer, but the plasma is kept away from the second metal layer by the dielectric layer until the pressure reaches the point where shearing occurs. DOE

N92-18565# Pacific Northwest Lab., Richland, WA.
THERMAL CONDUCTIVITIES OF THIN, SPUTTERED OPTICAL FILMS
C. H. Henager, Jr. and W. T. Pawlewicz May 1991 33 p
(Contract DE-AC06-76RL-01830)
(DE92-004486; PNL-SA-19687) Avail: NTIS HC/MF A03

The normal component of the thin film thermal conductivity has been measured for the first time for several advanced sputtered optical materials. Included are data for single layers of boron nitride (BN), aluminum nitride (AlN), silicon aluminum nitride (Si-Al-N), silicon aluminum oxynitride (Si-Al-O-N), silicon carbide (SiC), and for dielectric-enhanced metal reflectors of the form Al(SiO2/Si3N4)(n) and Al(Al2O3/AlN)(n). Sputtered films of more conventional materials like SiO2, Al2O3, Ta2O5, Ti, and Si have also been measured. The data show that thin film thermal conductivities are typically 10 to 100 times lower than conductivities for the same materials in bulk form. Structural disorder in the amorphous or very fine-grained films appears to account for most of the conductivity difference. Conclusive evidence for a film/substrate interface contribution is presented. DOE

N92-18602# Los Alamos National Lab., NM.
PROCEEDINGS OF THE PILAC OPTICS WORKSHOP
Nov. 1991 650 p Workshop held in Los Alamos, NM, 12-13 Aug. 1991
(Contract W-7405-eng-36)
(DE92-004653; LA-UR-91-3436; CONF-9108183) Avail: NTIS HC/MF A99

This report contains viewgraphs on the following topics: PILAC overview; PILAC injection line; PILAC general-purpose line design;

program RAYTRACE; design & performance of MRS; program MOTER; recent upgrades of MOTER; use of MOTER at Michigan State; spectrometer design at Michigan State; use of MOTER at CEBAF & related topics; TOSCA calculations at CEBAF; TOSCA calculations for PILAC; measurements of EPICS quadrupoles; quadrupole measurements and analysis at Bates Laboratory; analysis of 3D quadrupole data; quadrupole 3D fringe fields (theoretical lecture); analysis of 3D field data; analysis of dipole fringe fields; quadrupoles with perfect N=2 symmetry; CEBAF superconducting cos (20) quadrupole; upgrades to TRANSPORT and TURTLE; optics using differential algebra; and a possible test of quad optics using EPICS. DOE

N92-18707# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
SPATIAL OPTIC MULTIPLEXER/DIPLEXER Patent Application
P. L. Tremblay, inventor (to DOE) 22 Jun. 1990 16 p
(Contract DE-AC07-76ID-01570)
(DE92-003813; US-Patent-Appl-SN-542215;
Patents-US-A7542215) Avail: NTIS HC/MF A03

The present invention relates generally to secure fiber optic communications and more particularly to an apparatus which effects the efficient coupling of light from multiple optic fibers into a single optic fiber. This invention is comprises of an apparatus for simultaneous transmission of optic signals having different wavelengths over a single optic fiber. Multiple light signals are transmitted through optic fibers that are formed into a circumference surrounding a central core fiber. The multiple light signals are directed by a lens into a single receiving fiber where the light combines and is then focused into the central core fiber which transmits the light to a wavelength discriminating receiver assembly. DOE

N92-18739# Brookhaven National Lab., Upton, NY.
EXACT ANALYSIS TO ANY ORDER OF THE LINEAR COUPLING PROBLEM IN THE THIN LENS MODEL
A. G. Ruggiero 1991 18 p Presented at the 5th International Committee for Future Accelerators (ICFA) Beam Dynamics Workshop, Corpus Christi, TX, 3-8 Oct. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005005; BNL-46751; CONF-9110243-7) Avail: NTIS HC/MF A03

In this report, we attempt the exact solution of the motion of a charged particle in a circular accelerator under the effects of skew quadrupole errors. We adopt the model of error distributions, lumped in locations with zero extensions. This thin-lens approximation provides an analytical insight to the problem to any order. The total solution is expressed in terms of driving terms which are actually correlation factors to several orders. An application follows on the calculation and correction of tune-splitting and on the estimate of the role the higher-order terms play in the correction method. DOE

N92-18755# Oak Ridge National Lab., TN.
ALGORITHM FOR A NOVEL FIBER-OPTIC WEIGH-IN-MOTION SENSOR SYSTEM
K. W. Tobin, Jr. and J. D. Muhs Aug. 1991 10 p Presented at the SPIE Meeting, Boston, MA, 3-6 Sep. 1991
(Contract DE-AC05-84OR-21400)
(DE92-003538; CONF-9109230-8) Avail: NTIS HC/MF A02

Over the past decade, the demand from both government and private industry for small, lightweight, vehicle weigh-in-motion (WIM) systems has grown substantially. During the 1980s several techniques for weighing vehicles in motion were developed that include piezoelectric cables, capacitive mats, and hydraulic and bending-plate load cells. These different systems have advantages and disadvantages that trade off between accuracy, physical size, and system complexity. The smaller portable systems demonstrate medium to poor accuracy and the larger more accurate systems are nonportable. A small, lightweight, and portable WIM system based on a fiber-optic pressure transducer has been developed by Oak Ridge National Laboratory (ORNL) to meet the demands of government and industry. The algorithm for extracting vehicle weight from the time-dependent sensor response is developed and presented in this report, along with data collected by the system for several classes of vehicles. These results show that the ORNL fiber-optic WIM system is a viable alternative to other commercial systems that are presently available. DOE

N92-18804# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
SOLID COLLOIDAL OPTICAL WAVELENGTH FILTER Patent Application
J. L. Alvarez, inventor (to DOE) 30 May 1990 16 p
(Contract DE-AC07-76ID-01570)
(DE92-003980; US-Patent-Appl-SN-530673;
Patents-US-A7530673) Avail: NTIS HC/MF A03

A method for constructing a solid colloidal optical wavelength filter is discussed. The device was developed to filter optical wavelengths for spectroscopy, protection from intense radiation, monochromatizing, and analyzing optical radiation. The filter is formed by suspending spherical particles in a coagulable medium (such as setting plastic); agitating the particles and coagulable medium to produce an emulsion of particles suspended in the coagulable medium; and allowing the coagulable medium and suspended emulsion of particles to cool. DOE

N92-18811*# Smithsonian Astrophysical Observatory, Cambridge, MA.
ITERATIVE DECONVOLUTION OF X RAY AND OPTICAL SNR IMAGES Final Report, 1 Jun. 1990 - 30 Nov. 1991
Peter Nisenson, Clive Standley, and John Hughes Feb. 1992 68 p
(Grant NAG5-1364)
(NASA-CR-189906; NAS 1.26:189906) Avail: NTIS HC/MF A04 CSCL 20F

Blind Iterative Deconvolution (BID) is a technique which was originally developed to correct the degrading effects of atmospheric turbulence on astronomical images from single short exposure, high signal-to-noise-ratio frames. At the Center for Astro physics, we have implemented a version of BID following the general approach of Ayers and Dainty (1988), but extending the technique to use Wiener filtering, and developed it for application to high energy images from Einstein and ROSAT. In the optical, the point spread function (PSF) that degrades the images is due to a combination of telescope and atmospheric aberrations. At high energies, the degrading function is the instrument response function, which is known to be time and energy level unstable. In both cases, the PSF is poorly known, so BID can be used to extract the PSF from the image and then deconvolve the blurred image to produce a sharpened image. Other aspects of this technique are discussed. Author

N92-18861# Texas A&M Univ., College Station. Dept. of Physics.
DEMONSTRATION OF THE MEASUREMENT OF LIGHT SCATTERING AT AN ANGLE OF ZERO DEGREES FROM A SINGLE PARTICLE Final Report, 1 Jun. - 30 Sep. 1991
Edward S. Fry 23 Oct. 1991 22 p
(Contract DAAL03-91-G-0200)
(AD-A244397; RF-6876; ARO-29054.2-GS) Avail: NTIS HC/MF A03 CSCL 20/6

Measurements of light scattering by a glass fiber at an angle of 0 deg were successfully made at a wavelength of 0.5145 micrometers. Data were obtained as a function of fiber radii from 1 micrometer to 35 micrometers and are in excellent agreement with theory. This new measurement technique is based on the fanning of a coherent light beam in a photorefractive BaTiO3 crystal. The use of fanning is a variant on the beam coupling technique originally proposed; and since it is a much more robust approach, it is a significant additional accomplishment under this grant. GRA

N92-18902# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
MODELING AND ELABORATION OF AN INTEGRATED INFRARED DETECTOR ASSOCIATING A HgCdTe PHOTOCONDUCTOR WITH A GaAs FIELD-EFFECT TRANSISTOR Ph.D. Thesis - Toulouse Univ.
Jean-Luc Filippozzi 1991 150 p In FRENCH; ENGLISH summary
(LAAS-91233; ETN-92-90668) Avail: NTIS HC/MF A07

The technological feasibility of an optical receiver which integrates an HgCdTe detector with a GaAs field effect transistor is studied. Rules for optimizing the technological and electrical parameters are defined. The main characteristics studied are the noise figure and the ratio of the transconductance of the square of the capacity for the transistor, and quantum efficiency, spectral response, and detectivity of the photoconductor. Optical receiver simulation shows that the transistor improved the photoconductor response and with little loss in detectivity. It seems that the major difficulty in compatibility is associated with the presence of stepped HgCdTe surfaces. ESA

N92-18918# Laboratoire d'Automatique et d'Analyse des Systemes, Toulouse (France).
STUDY AND REALIZATION OF AN OBSTACLE DETECTION INFRARED SYSTEM FOR AUTOMOTIVE USE Ph.D. Thesis - Toulouse Univ.
Mohammed AlaouiAmine 1991 123 p In FRENCH; ENGLISH summary
(LAAS-91223; ETN-92-90667) Avail: NTIS HC/MF A06

The main technological options available in the field of obstacle detection are presented. Ultrasound, microwave, and infrared detection systems are reviewed. The reasons for choosing an infrared solution are outlined. The problems involved in developing an obstacle detection system in the near infrared are discussed. Weather condition effects, interference limitations due to multiple onboard sensors, and range detection influence are some of the problems studied. A collimated, mechanically scanned, and pulsed infrared beam is proposed to overcome some of these problems. Performances of a first and second prototype made using this system are presented. ESA

N92-19001*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, AL.
OPTICAL SYNTHESIZER FOR A LARGE QUADRANT-ARRAY CCD CAMERA: CENTER DIRECTOR'S DISCRETIONARY FUND Final Report
Mona J. Hagyard Jan. 1992 28 p
(NASA-TM-103571; NAS 1.15:103571) Avail: NTIS HC/MF A03 CSCL 20F

The objective of this program was to design and develop an optical device, an optical synthesizer, that focuses four contiguous quadrants of a solar image on four spatially separated CCD arrays that are part of a unique CCD camera system. This camera and the optical synthesizer will be part of the new NASA-Marshall Experimental Vector Magnetograph, and instrument developed to measure the Sun's magnetic field as accurately as present technology allows. The tasks undertaken in the program are outlined and the final detailed optical design is presented. Author

75 PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion.

For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics.*

N92-18059# Wisconsin Univ., Madison.
THEORETICAL REVERSED FIELD PINCH STUDIES
1991 9 p
(Contracts DE-FG02-85ER-53212; DE-FG02-89ER-53291; DE-AC03-83ER-53150; DE-FG02-86ER-53218)
(DE92-004419; DOE/ER-53212/178) Avail: NTIS HC/MF A02

This report discusses nonlinear RFP behavior with nonideal boundaries; three dimensional RFP equilibria with field errors; self-consistent current density transport from microturbulence; turbulence studies in the RFP; coupled rippling and g-mode turbulence; microtearing turbulence; feedback of resistive wall instabilities; anomalous ion heating from the dynamo; effect of fluctuations on tearing instability; and thermal alfven wave fluctuations. DOE

N92-18087# Lawrence Livermore National Lab., CA.
MEASUREMENTS AND MODELS OF THE OPACITY OF HOT, DENSE PLASMA
P. T. Springer, T. S. Perry, D. F. Fields, W. H. Goldstein, B. G. Wilson, and R. E. Stewart Aug. 1991 8 p Presented at the 8th Topical Conference on Atomic Processes in Plasmas, Portland, ME, 25-29 Aug. 1991
(Contract W-7405-eng-48)
(DE92-004654; UCRL-JC-107675; CONF-9108105-4) Avail: NTIS HC/MF A02

In order to test and improve opacity models, we are performing experiments to accurately characterize and measure the opacity of high-Z plasmas. In the experiments the NOVA laser at Lawrence Livermore National Laboratory is used to indirectly heat tamped thin foil targets containing mid to high-Z ions of interest which are co-mixed with low-Z ions for spectroscopic determinations of plasma conditions. One of the NOVA beams is used to create a source of x-rays of backlighting the plasma face-on, while another beam is used to perform a radiograph of the expanding sample edge-on. X-rays that pass through and around the plasma are simultaneously measured on high resolution crystal spectrometers, and the opacity is measured by comparing the direct and attenuated x-ray spectra. Plasma density is determined from the spatial extent of the expanded plasma, and plasma temperature is inferred from the ionization distribution of the low-Z ions doped in the plasma. Predictions of the high-Z opacity are then compared with data using measured conditions as input. These are the first high temperature opacity measurements in which sample conditions are simultaneously determined. We present measurements and predictions for a spectroscopic experiment using a comixture of aluminum and niobium. We discuss plans for future improvements, and for spectroscopic measurements in the spectral region determining Rosseland mean opacities. DOE

N92-18090# General Sciences Corp., Souderton, PA.
AN MHD HEAT SOURCE BASED ON INTERMETALLIC REACTIONS
H. Sadjian, P. Zavitsanos, and C. H. Marston (Villanova Univ., PA.) May 1991 72 p
(Contract DE-AC22-87PC-79679)
(DE92-000036; DOE/PC-79679/T1) Avail: NTIS HC/MF A04

The main objective of this program was the development of an MHD heat source of potential use in Space-Based Multi-Megawatt, MHD Power Systems. The approach is based on extension of high temperature chemical/ion release technology developed by the General Sciences, Incorporated (GSI) team and successfully applied in other space applications. Solid state reactions have been identified which can deliver energy densities and electrons in excess of those from high energy explosives as well as other conventional fuels. The use of intermetallic reactions can be used to generate hot hydrogen plasma from the reaction, to create a high level of seedant ionization, and can be packaged as cartridge type fuels for discrete pulses. The estimated weight for energizing a (100 MW - 1000 sec) Pulsed MHD Power System can range from 12 to 25 x 10(exp 3) kg depending on reaction system and strength of the magnetic field. The program consisted of two major tasks with eight subtasks designed to systematically evaluate these concepts in order to reduce fuel weight requirements. Laboratory measurements on energy release, reaction product identification, and levels of ionization were conducted in the first task to screen candidate fuels. The second task addressed the development of a reaction chamber in which conductivity, temperature, and pressure were measured. Instrumentation was developed to measure these parameters under

high temperature pulsed conditions in addition to computer programs to reduce the raw data. Measurements were conducted at GSI laboratories for fuel weights of up to 120 grams and at the Franklin Research Center for fuel weights up to 1 kilogram. The results indicate that fuel weight can be scaled using modular packaging. Estimates are presented for fuel weight requirements. DOE

N92-18098# Sandia National Labs., Albuquerque, NM.
DEPOSITION OF DEUTERIUM AND METALS ON DIVERTOR TILES IN THE DIII-D TOKAMAK
D. S. Walsh, B. L. Doyle, and G. L. Jackson (General Atomic Co., San Diego, CA.) 1991 16 p Presented at the 38th National Symposium of the American Vacuum Society, Seattle, WA, 11-15 Nov. 1991
(Contract DE-AC04-76DP-00789)
(DE92-003648; SAND-91-1163C; CONF-911132-7) Avail: NTIS HC/MF A03

Hydrogen recycling and impurity influx are important issues in obtaining high confinement discharges in the D3-D tokamak. To reduce metallic impurities in D3-D, 40 percent of the wall area, including the highest heat flux zones, have been covered with graphite tiles. However erosion, redeposition and hydrogen retention in the tiles, as well as metal transport from the remaining Inconel walls can lead to enhanced recycling and impurity influx. Hydrogen and metal retention in divertor floor tiles have been measured using external ion beam analysis techniques following four campaigns where tiles were exposed to several thousand tokamak discharges. The areal density of deuterium retained following exposure to tokamak plasmas was measured with external nuclear reaction analysis. External proton-induced x-ray emission analysis was used to measure the areal densities of metallic impurities deposited upon the divertor tiles either by sputtering of metallic components during discharges or as contamination during tile fabrication. Measurements for both deuterium and metallic impurities were taken on both the tile surfaces which face the operating plasma and the surfaces on the side of the tiles which form the small gaps separating each of the tiles in the divertor. The highest areal densities of both deuterium and metals were found on the plasma-facing surface near the inner strike point region of each set of divertor tiles. Significant deposits, extending as fast a 1 cm from the plasma-facing and containing up to forty percent of the total divertor deposition, were also observed on the gap-forming surfaces of the tiles. DOE

N92-18138# Argonne National Lab., IL.
TRITIUM TRANSPORT IN LITHIUM CERAMICS POROUS MEDIA
S. W. Tam and V. Ambrose 1991 19 p Presented at the International Conference on Fusion Reactor Materials, Clearwater, FL, 17-22 Nov. 1991
(Contract W-31-109-eng-38)
(DE92-004146; ANL/CP-72864; CONF-911111-11) Avail: NTIS HC/MF A03

A random network model has been utilized to analyze the problem of tritium percolation through porous Li ceramic breeders. Local transport in each pore channel is described by a set of convection-diffusion-reaction equations. Long range transport is described by a matrix technique. The heterogeneous structure of the porous medium is accounted for via Monte Carlo methods. The model was then applied to an analysis of the relative contribution of diffusion and convective flow to tritium transport in porous lithium ceramics. DOE

N92-18166# International Centre for Theoretical Physics, Trieste (Italy).
LOW FREQUENCY RESPONSE OF A DUSTY PLASMA
M. Salimullah and A. Sen Jul. 1991 7 p
(DE92-609364; IC-91/146) Avail: NTIS HC/MF A02

The dielectric properties of a plasma embedded with charged dust particles are examined. The presence of dust introduces a background inhomogeneous electric field which significantly influences the dispersion properties of the plasma medium. At low frequencies, we find important modifications of the ion acoustic branch as well as the existence of a new mode arising from the oscillations of the ions in the static structure of the dust distribution. DOE

N92-18227# Wisconsin Univ., Madison. Dept. of Nuclear Engineering and Engineering Physics.
MAGNETIC CONFINEMENT FUSION PLASMA THEORY, TASK 1
J. D. Callen Jul. 1991 24 p
(Contract DE-FG02-86ER-53218)
(DE91-019077; DOE/ER-53218/17) Avail: NTIS HC/MF A03

A few key tokamak plasma confinement and heating theory issues are presented. Among those areas discussed are the following: extensive development of a new Chapman-Enskog type fluid/kinetic hybrid approach to deriving rigorously valid fluid moment equations; applications of this new formalism; interactions of fluctuating bootstrap current driven magnetic islands; and determination of net transport processes and equations for a tokamak. Recent progress and publications in these areas, and in the management of the local NERSC node and fusion theory DECstation 5000 at UW-Madison are also summarized. DOE

N92-18228# Wisconsin Univ., Madison. Dept. of Electrical and Computer Engineering.
AUXILIARY RADIOFREQUENCY HEATING OF TOKAMAKS, TASK 3
J. E. Scharer Jul. 1991 21 p
(Contract DE-FG02-86ER-53218)
(DE91-019078; DOE/ER-53218/18) Avail: NTIS HC/MF A03

Several key tokamak Ion Cyclotron Range of Frequencies (ICRF) coupling and heating issues are discussed. Among the issues presented are the following: efficient coupling during the L to H mode transition by analysis and computer simulation of ICRF antenna edge plasma profiles; analysis of both dielectric filled waveguide and coil ICRF antenna coupling to plasma edge profiles; benchmarking the codes to compare with current JET, D-IIID and ASDEX experimental results; ICRF full wave field solutions, power conservation, and heating analyses; and the effects of fusion alpha particle or ion tail populations on the ICRF absorption. DOE

N92-18403# Wisconsin Univ., Madison.
PLASMA PHYSICS RESEARCH IN THE MST TOROIDAL CONFINEMENT DEVICE
1991 4 p
(Contract DE-FG02-85ER-53198)
(DE92-004056; DOE/ER-53198/179) Avail: NTIS HC/MF A01

MST has matured in its operation to the point that substantial physics results are emerging. This paper contains accomplishments in FY 91 separated into physics results, diagnostic improvements, and machine improvements. In addition to achievements of the eight months which covers 1 Nov. 1990 to 15 Jul. 1991, we include the expected progress in the remaining four months of the grant period. DOE

N92-18433# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). Lab. Associado de Plasma.
NEUTRAL BEAM SHINETHROUGH IN TBR-E
Antonio Montes Jun. 1991 6 p Submitted for publication
(INPE-5259-PRE/1683) Avail: NTIS HC/MF A02

The absorption is discussed of tangentially injected neutral beams in tritium breeding reactor (TBR)-E. Injection roughly tangent to the magnetic axis (tangential injection) is generally preferred because this leads to maximum beam plasma interaction length and consequently beam absorption. The geometry for tangential injection is illustrated. The relevant atomic processes are briefly discussed along with the absorption of a pencil beam caused by these processes. Author

N92-18523# International Centre for Theoretical Physics, Trieste (Italy).
ULTRARELATIVISTIC MODULATION AND FILAMENTATION INSTABILITIES IN A LASER-PRODUCED PLASMA

M. Salimullah, A. A. Mamun, and F. Majid (Jahangirnagar Univ., Dacca, Bangladesh) Aug. 1991 27 p
(DE92-603860; IC-91/232) Avail: NTIS HC/MF A03

A rigorous theoretical investigation is made on the ultrarelativistic modulation and filamentation instabilities in a collisionless and unmagnetized laser-produced plasma. The kinetic description of the laser-produced plasma, viz., the relativistic Vlasov equation has been employed to find the nonlinear response of electrons for the four-wave parametric processes in the plasma. It is noted that the modulation and filamentation instabilities have significant relativistic effects and the growth rates of both the instabilities in the ultrarelativistic consideration are approximately c(exp 2)/v(exp 2)(sub e) times higher than those in the nonrelativistic consideration, where c and v(sub e) are the free-space speed of light and the thermal speed of the plasma electrons. DOE

N92-18524# International Centre for Theoretical Physics, Trieste (Italy).
STIMULATED BRILLOUIN SCATTERING OF ELECTROMAGNETIC WAVES IN A DUSTY PLASMA
M. Salimullah and A. Sen Aug. 1991 13 p
(DE92-603865; IC-91/233) Avail: NTIS HC/MF A03

The stimulated Brillouin scattering of electromagnetic waves in a homogeneous, unmagnetized and collisionless dusty plasma has been investigated theoretically. The Vlasov equation has been solved perturbatively to find the nonlinear response of the plasma particles. The presence of the dust particles introduces a background inhomogeneous electric field which significantly influences the dispersive properties of the plasma. At the ion acoustic branch we find the usual scattering slightly modified by the charged dust grains. However, at the frequency lower than the ion acoustic branch we find a new mode of the plasma arising from the oscillations of the ions in the static structure of the dust distribution. This low frequency branch causes enhanced stimulated Brillouin scattering of electromagnetic waves in a dusty plasma. DOE

N92-18532# International Centre for Theoretical Physics, Trieste (Italy).
THE STRUCTURE OF MFD SHOCK WAVES IN A MODEL OF PLASMA
M. Hesaaraki May 1991 27 p
(DE92-603866; IC-91/69) Avail: NTIS HC/MF A03

The question of the existence of structure of shock waves in the case of rectilinear, purely transverse magnetic fields in MFD plasma is described by Germain; and a proof of existence for the case of neglecting viscosity and heat conduction are given. The mathematical question is stated in terms of a four-dimensional system of ordinary differential equations which depends on four viscosity parameters. These equations admit two rest points, independent of viscosity parameters. The problem considered in this article is to show that for all values of the viscosities, there is an orbit running from one rest point to the other. Moreover, the shock is stable or has the usual type of profile. In order to solve the above problem, we show that our system is gradient-like (except for the very special case eta = kappa = sigma (exp -1) = 0). This result enables us to use the Conley theory and solve the problem. Moreover, some limiting cases for singular viscosities are investigated; in particular, we show how the general results of the MHD theory are obtained when 'the plasma viscosity' (beta) tends to zero. DOE

N92-18533# International Atomic Energy Agency, Vienna (Austria).
RESEARCH AND DEVELOPMENT NEEDS FOR ITER ENGINEERING DESIGN
C. Flanagan, ed. Aug. 1991 162 p
(DE92-603872; INIS-MF-13011) Avail: NTIS HC/MF A08

In the series of documents that summarize the results of the Conceptual Design Activities (CDA) for the International Thermonuclear Experimental Reactor (ITER), this document describes the research and development (R and D) plans for 1991 - 1995. Part A describes the physics R and D, and Part B the technology R and D. The physics R and D needs are presented in terms of task descriptions of an ITER-related R and D program for 1991/1992 and beyond, while diagnostics R and D needs, although covered in Appendix A, are described in Part B. In Chapter 2 of Part A, 'ITER-related Physics R and D Needs for 91/92 and Beyond', the following tasks are described as most crucial: (1) demonstration that (a) operation with a cold divertor plasma is possible, (b) the peak heat flux onto the divertor plate can be kept below about 10 MW per square meter, and (c) helium exhaust conditions allow a fractional burnup of about three percent or more; (2) a characterization of disruptions that allows to specify their consequences for the plasma-facing-components, and that provides evidence that the number of disruptions expected allows acceptable plasma-facing-component lifetimes; (3) demonstration that steady-state operation in an enhanced-confinement regime and satisfactory plasma purity is possible, and provision of energy confinement scaling allowing the prediction of ITER performance; and (4) ensurance that the presence of a fast ion population does not jeopardize plasma performance in ITER. Part B, 'ITER Technology Research and Development Needs', describes planning R and D for magnets, containment structure, assembly and maintenance, current drive and heating, plasma facing components, blanket, fuel cycle, structural materials, and diagnostics. A table of key milestones for technology R and D is included, as well as cost estimates. DOE

N92-18557# Illinois Univ., Urbana.
METHODS FOR TESTING TRANSPORT MODELS
C. Singer and D. Cox 14 Nov. 1991 15 p
(Contract DE-FG02-88ER-53269)
(DE92-004489; DOE/ER-53269/4) Avail: NTIS HC/MF A03

Substantial progress has been made over the past year on six aspects of the work supported by this grant. As a result, we have in hand for the first time a fairly complete set of transport models and improved statistical methods for testing them against large databases. We also have initial results of such tests. These results indicate that careful application of presently available transport theories can reasonably well produce a remarkably wide variety of tokamak data. DOE

N92-18676# International Centre for Theoretical Physics, Trieste (Italy).
PARAMETRIC EXCITATION OF ALFVEN AND HELICON WAVES IN A MAGNETOACTIVE COMPENSATED SEMICONDUCTOR BY MICROWAVE RADIATION
M. Salimullah and A. A. Mamun (Jahangirnagar Univ., Dacca, Bangladesh) Jul. 1991 25 p
(DE92-603807; IC-91/187) Avail: NTIS HC/MF A03

A theoretical investigation is made on the parametric excitation of electromagnetic Alfven and helicon waves by a microwave radiation in a magnetoactive solid state plasma, viz., compensated germanium. The Krook model has been used to solve the Boltzmann transport equation to find the nonlinear response of electrons and holes in the highly collisional semiconductor plasma. It is noted that the growth rate of excitation of helicon waves is one order higher than that for the Alfven wave excitation for the same set of plasma parameters. The excitation of the Alfven and helicon waves for parallel propagation is higher than that for the transverse propagation of the incident microwave. DOE

N92-18678# Melbourne Univ., Parkville (Australia). School of Physics.
DIELECTRIC RESPONSE OF PLANAR RELATIVISTIC QUANTUM PLASMAS
D. C. Bardos and N. E. Frankel 1991 54 p
(DE92-603838; UM-P-91/40) Avail: NTIS HC/MF A04

The dielectric response of planar relativistic charged particle-antiparticle plasmas is investigated, treating Fermi and Bose plasmas. The conductivity tensor in each case is derived in the self-consistent Random Phase Approximation. The tensors are then evaluated at zero temperature for the case of no external fields, leading to explicit dispersion relations for the electrodynamic

modes of the plasma. The longitudinal and transverse modes are in general coupled for plasma layers. This coupling vanishes, however, in the zero field case, allowing 'effective' longitudinal and transverse dielectric functions to be defined in terms of components of the conductivity tensor. Solutions to the longitudinal mode equations (i.e., plasmon modes) are exhibited, while purely transverse modes are found not to exist. In the case of the Bose plasma the screening of a test charge is investigated in detail. DOE

N92-18685# Texas Univ., Austin. Inst. for Fusion Studies.
NEOCLASSICAL DIFFUSION IN A TURBULENT PLASMA
P. Yushmanov (Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow, USSR) Nov. 1991 22 p
(Contract DE-FG05-80ET-53088)
(DE92-004248; DOE/ET-53088/524; IFSR-524) Avail: NTIS HC/MF A03

This work describes a new approach to plasma transport where the toroidal drift motion is considered as a perturbation to the fluctuating velocity. Percolation theory is used to determine the scaling of the diffusion coefficient. Several neoclassical phenomena should persist even when diffusion is enhanced from neoclassical predictions. Numerical simulation results support the theoretical scaling arguments. DOE

N92-18686# Texas Univ., Austin. Inst. for Fusion Studies.
TOROIDAL KINETIC (ETA)(SUB i)-MODE STUDY IN HIGH TEMPERATURE PLASMAS
J. Q. Dong, W. Horton, and H. T. Junm Nov. 1991 32 p
(Contract DE-FG05-80ET-53088)
(DE92-004252; DOE/ET-53088/527; IFSR-527) Avail: NTIS HC/MF A03

A new kinetic integral equation for the study of the ion temperature gradient driven mode in toroidal geometry is developed that includes the ion toroidal (curvature and magnetic gradient) drift motion omega sub D, the mode coupling from finite kappa sub (parallel) due to the toroidal feature of the sheared magnetic configuration. The integral equation allows the stability study for arbitrary kappa sub (parallel) upsilon sub i/(omega - omega sub D) and kappa (perpendicular) rho sub i. A systematic parameter study is carried out for the low beta circular flux surface equilibrium. Possible correlations between the unstable mode characteristics and some experimental results such as fluctuation spectrum and anomalous ion transport measurements are discussed. DOE

N92-18693# International Atomic Energy Agency, Vienna (Austria).
PLASMA PHYSICS NETWORK NEWSLETTER, NO. 3
Feb. 1991 19 p
(DE92-603836; INIS-MF-13007) Avail: NTIS HC/MF A03

This issue of the Newsletter contains a report on the First South-North International Workshop on Fusion Theory, Tipaza, Algeria, 17-20 September, 1990; a report in the issuance of the 'Buenos Aires Memorandum' generated during the IV Latin American Workshop on Plasma Physics, Argentina, July 1990, and containing a proposal that the IFRC establish a 'Steering Committee on North-South Collaboration in Controlled Nuclear Fusion and Plasma Physics Research'; the announcement that the 14th International Conference on Plasma Physics and Controlled Nuclear Fusion will be held in Wuerzburg, Germany, September 30 to October 7, 1992; a list of IAEA technical committee meetings for 1991; an item on ITER news; an article 'Long Term Physics R and D Planning (for ITER)' by F. Engelmann; in the planned sequence of 'Reports on National Fusion Programs' contributions on the Chinese and Yugoslav programs; finally, the titles and contacts for two other newsletters of potential interest, i.e., the AAAPT (Asian African Association for Plasma Training) Newsletter, and the IPG (International physics Group-A sub unit of the American Physical Society) Newsletter. DOE

N92-18694# International Atomic Energy Agency, Vienna (Austria).
PLASMA PHYSICS NETWORK NEWSLETTER, NO. 4
Aug. 1991 15 p
(DE92-603837; INIS-MF-13008) Avail: NTIS HC/MF A03

This fourth issue of the Newsletter contains a (1) contribution in the series of reports on national fusion programs from Algeria; (2) a letter from Dr J. A. M. de Villiers, manager: fusion studies, at the Atomic Energy Corporation of South Africa Limited, informing about the close down of the small tokamak project there, and soliciting ways to use some manpower and supportive sources to salvage the wealth of information still left behind in the project, and offering, in the possible absence of such manpower and supportive sources, the entire facility for sale (specifications of the Tokoloshe Tokamak plus diagnostic systems are enclosed); (3) the e-mail address of the Third World Plasma Research Network (TWPRN), namely: 'PLASNET.NERUS.PFC.MIT.EDU'; (4) minutes of the TWPRN Steering Committee Meeting held in May 1991, at the I.C.T.P., Trieste, Italy; (5) a news item on the ITER Tokamak project; (6) a reiteration of the announcement of the 14th IAEA International Conference on Plasma Physics and Controlled Nuclear Fusion Research, to be held in Wuerzburg, Germany, September 30 to October 7, 1992; (7) a list of IAEA Technical Committee Meetings during 1991; (8) the First Announcement of the V Latin American Workshop on Plasma Physics, to be held in Mexico City, July 21-30, 1992, accompanied with a call for papers; all correspondence on this conference should be addressed to: Dr. Julio Herrera, V LAWPP, ICN-UNAM, Apdo. Postal 70-543, Delegacion Coyoacan, 04510 Mexico, D.F. Mexico (e-mail: 'HERRE.UNAMVM1.BITNET'); (9) the announcement for the Second South North International Workshop on Fusion Theory, Lisbon, Portugal, March 1993 (contact: Pr. Tito Mendonca, Centro de Electrodinamica, Instituto Superio Tecnico, 1096 Lisbon Codex, Portugal). DOE

N92-18701# General Atomic Co., San Diego, CA.
DISPLAYING D3-D PLASMA DATA USING DEC'S X WINDOW SYSTEM
K. L. Greene Nov. 1991 3 p Presented at the 14th IEEE Symposium on Fusion Engineering, San Diego, CA, 30 Sep. - 3 Oct. 1991
(Contract DE-AC03-89ER-51114)
(DE92-004456; GA-A-20610; CONF-910968-54) Avail: NTIS HC/MF A01

The D3-D tokamak program, funded by the Department of Energy, carries out plasma physics and fusion energy research experiments. The machine began operation in February 1986; at that time, approximately 7 Mbytes of data was collected for shot. Since that time, the shot size has steadily increased to over 50 Mbytes with the average shot size between 35 and 45 Mbytes. Shots are fired every 12 to 15 minutes and last approximately 5 to 10 seconds. Between 30 and 40 shots are fired each day when plasma experiments are scheduled. In 1987 MFITD and MFITPLAY were written/modified. These two programs provide graphical output that allows the users to see, before the next shot, the plasma shape and the locations of the plasma and magnetic flux lines within the tokamak. MFITD performs the computations which calculate the shape and location of the plasma; it also graphically displays a small subset of timeslice data. MFITPLAY graphically displays the full set of timeslice data. Through interactive commands, MFITPLAY also allows the user to control the various aspects of how the data is displayed. In 1990, both programs were converted from User Interface Services (UIS) routines, which are part of the MicroVMS workstation graphics software, to DEC's X Window System using the DECWindows window manager. These modifications were required because of a move by Digital Equipment Corporation (DEC) to support X windows and phase out UIS. Due to the nature and purpose of each program, MFITD needed only simple graphics conversion while MFITPLAY was completely rewritten. The DECWindows version of MFITPLAY offers a number of improvements, such as a more intuitive user interface. DOE

N92-18702# General Atomics Technologies Corp., San Diego, CA.
INITIAL BORONIZATION OF THE D3-D TOKAMAK
J. Phillips, T. Hodapp, K. Holtrop, G. Jackson, and J. Winter Oct. 1991 14 p Presented at the 38th National Symposium of the American Vacuum Society, Seattle, Wa, 11-15 Nov. 1991
(Contract DE-AC03-89ER-51114)
(DE92-004457; GA-A-20750; CONF-911132-9) Avail: NTIS HC/MF A03

A system has been installed to deposit a thin film of elemental boron to the walls of the D3-D tokamak, in order to reduce the influx of impurities during plasma discharges. Subsequently new regimes of substantially tokamak energy confinement were obtained. The deposition of the boron layer is achieved during a glow discharge session using a helium-diborane age mixture and a film of approx. 100 nm is deposited. The boronization system includes special storage and handling precautions for the diborane, a delivery and metering system for the glow discharge, modifications to the tokamak's residual gas analyzer system, and a dedicated system for handling and neutralizing the exhaust gas from the tokamak. Tokamak discharges with similar parameters before and after boronization are used to characterize the effects of the boron film. Nickel has been reduced by a factor of 30, while impurities such as oxygen and carbon are reduced fivefold. A system of pulsing the flow discharge has been developed in order to improve the uniformity of the film applied. DOE

N92-18746# Texas Univ., Austin. Inst. for Fusion Studies.
EXISTENCE AND DAMPING OF TOROIDICITY-INDUCED ALFVEN EIGENMODES
S. M. Mahajan and R. R. Mett Dec. 1991 15 p
(Contract DE-FG05-80ET-53088)
(DE92-004250; DOE/ET-53088/531; IFSR-531) Avail: NTIS HC/MF A03

A new method of analyzing the toroidicity-induced Alfven eigenmode (TAE) from kinetic theory is presented. The analysis includes electron parallel dynamics non-perturbatively, an effect which is found to strongly influence the character and damping of the TAE -- contrary to previous theoretical predictions. The normal electron Landau damping of the TAE is found to be higher than previously expected, and may explain recent experimental measurements of the TAE damping coefficient. DOE

N92-18747# Texas Univ., Austin. Inst. for Fusion Studies.
SELF-CONSISTENT RADIAL SHEATH IN IGNITED PLASMAS
H. Xiao, R. D. Hazeltine, and R. Carrera Nov. 1991 13 p
(Contract DE-FG05-80ET-53088)
(DE92-004251; DOE/ET-53088/525; IFSR-525) Avail: NTIS HC/MF A03

The radial sheath in ignited plasmas is studied based on the self-consistent effects of alpha particle's guiding-center orbits and E x B-induced toroidal rotation. The slowing-down alpha particle distribution determines the structure of the radial sheath through finite Larmor radius effects. DOE

N92-18803# Lawrence Livermore National Lab., CA.
X RAY OPTICS FOR PLASMA DIAGNOSTICS
L. V. Knight (Brigham Young Univ., Provo, UT.) Aug. 1991 12 p
(Contract W-7405-eng-48)
(DE92-003967; UCRL-CR-108465) Avail: NTIS HC/MF A03

This report summarizes the work performed by Brigham Young University (BYU) while under contract with the Advanced X-ray Optics Program (AXOP) at Lawrence Livermore National Laboratory (LLNL) from Oct. 1988 to Jan. 1991. The main accomplishments were in the areas of characterization of x-ray optical components, upgrading AXOP's X-ray CCD camera, and completing an initial design study for a high-energy (10 KeV) x-ray microscope. Progress in each of these areas is outlined. DOE

N92-18852# Wisconsin Univ., Madison.
ION HEATING AND MHD DYNAMO FLUCTUATIONS IN THE REVERSED FIELD PINCH
E. Scime, S. Hokin, C. Watts, and N. Mattor Jan. 1992 13 p
(Contract DE-FG02-85ER-53198)
(DE92-005229; DOE/ER-53198/185) Avail: NTIS HC/MF A03

Ion temperature measurements, time resolved to 10 microns, have been made in the Madison Symmetric Torus reversed field pinch with a five channel charge exchange analyzer. The ion temperature, T(sub i) approx. = 200 eV for I = 350 kA, increases by as much as 100 pct. during discrete dynamo bursts in MST discharges. Magnetic field fluctuations in the range 0.5 to 5 MHz were also measured. Structure in the fluctuation frequency spectrum at the ion cyclotron frequency appears as the bursts terminate, suggesting that the mechanism of ion heating involves the dissipation of dynamo fluctuations at ion gyro-orbit scales. DOE

N92-18853# Wisconsin Univ., Madison.
CURRENT DENSITY FLUCTUATIONS AND AMBIPOLARITY OF TRANSPORT
W. Shen, R. N. Dexter, and S. C. Prager Oct. 1991 16 p
(Contract DE-FG02-85ER-53198)
(DE92-005231; DOE/ER-53198/183) Avail: NTIS HC/MF A03

The fluctuation in the plasma current density is measured in the MIST reversed field pinch experiment. Such fluctuations, and the measured radial profile of the k spectrum of magnetic fluctuations, supports the view and that low frequency fluctuations (f less than 30 kHz) are tearing modes and high frequency fluctuations (f between 30 to 250 kHz) are localized turbulence in resonance with the local equilibrium magnetic field (i.e., k x B = 0). Correlation of current density and magnetic fluctuations demonstrates that radial particle transport from particle motion parallel to a fluctuating magnetic field is ambipolar over the full frequency range. DOE

76 SOLID-STATE PHYSICS

Includes superconductivity.

For related information, see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers.*

N92-18019# International Centre for Theoretical Physics, Trieste (Italy).
CHARGED HARD SPHERES IN A UNIFORM NEUTRALIZING BACKGROUND: THE ROLE OF THERMODYNAMICS SELF-CONSISTENCE
Z. Badirkhan, G. Pastore, and M. P. Tosi (Trieste Univ., Italy) Jun. 1991 16 p
(DE92-609233; IC-91/113) Avail: NTIS HC/MF A03

Calculations of the thermodynamic properties and pair distribution function of a one-component classical fluid of charged hard spheres in a uniform neutralizing background are reported and compared with Monte Carlo results of Hansen and Weis. Thermodynamic self-consistency between the virial pressure and the fluctuations formula for the isothermal compressibility is enforced in the calculations by various alternative approaches. The role of thermodynamic self-consistency is crucial to obtain a satisfactory quantitative description of this model fluid, in view of its applications in the theory of liquid metals and of dispersions of charged colloidal particles. DOE

N92-18044# Academy of Sciences of the Ukrainian SSR, Kharkov. Fiziko-Tekhnicheskij Inst.
EMERGENCE OF COHERENT SURFACE STRUCTURES DURING SPUTTERING OF AMORPHOUS MATERIALS BY ION BEAMS
S. M. Latinskij, A. V. Tur, and V. V. Yanovskij 1990 9 p In RUSSIAN
(DE92-609291; KFTI-90-1) Avail: NTIS HC/MF A02

The process of production of complex coherent periodic structures on the sputtered material surface is investigated. The depth of the beam ion penetration to under the sputtered material surface depends on its form. This results in the sputtering coefficient local fluctuations corresponding to the surface

roughness: the rate of cavity sputtering would exceed that one of hillocks. The related instability, developing under the surface sputtering, can lead to the occurrence of surface structures. The basic unstable mode parameters (wave length, instability increment) are calculated within the framework of cascade theory and linear approximation. DOE

N92-18070# Sandia National Labs., Albuquerque, NM.
DIAMOND GROWTH AT LOW SUBSTRATE TEMPERATURES Patent Application
W. L. Hsu, inventor (to DOE) and D. M. Tung, inventor (to DOE) 24 Apr. 1990 12 p
(Contract DE-AC04-76DP-00789)
(DE92-004604; US-Patent-Appl-SN-513657;
Patents-US-A7513657) Avail: NTIS HC/MF A03

Diamond films are deposited on silicon wafers at a temperature of less than 600 C by a microwave plasma-assisted chemical vapor deposition process using methane in hydrogen as a source of carbon. DOE

N92-18171 Department of the Navy, Washington, DC.
MAGNETOSTRICTIVE LINEAR MOTOR Patent
Joseph P. Teter, inventor (to Navy) and Arthur E. Clark, inventor (to Navy) 13 Aug. 1991 7 p Filed 11 Oct. 1990 Supersedes N91-24505 (29 - 16, p 2620), AD-D014816
(AD-D015159; US-Patent-5,039,894; US-Patent-Appl-SN-607350; US-Patent-Class-310-26) Avail: US Patent and Trademark Office CSCL 20/2

The magnetostrictive rod of a linear motor is made of twinned single crystal Terfenol-D having its crystalline axis aligned with the rod axis to produce non-uniform transverse magnetostriction during axial magnetostrictive elongation of the rod in response to a triggering magnetic field. Slide bearing forces applied through spring based support plates are limited to flat surfaces formed on the rod perpendicular to transverse axis along which the rod is magnetostrictively contracted. GRA

N92-18188# California Univ., Berkeley. Lawrence Berkeley Lab.
FAR INFRARED CONDUCTIVITY OF CHARGE DENSITY WAVE MATERIALS AND THE OXYGEN ISOTOPE EFFECT IN HIGH-Tc SUPERCONDUCTORS Ph.D. Thesis
W. N. Creager Sep. 1991 265 p
(Contract DE-AC03-76SF-00098)
(DE92-004105; LBL-31390) Avail: NTIS HC/MF A12

The far infrared reflectance and conductivity of Ta(1-x)Nb(x)(Se4)2I and TaS3 have been measured to determine the origin of a huge infrared resonance that dominates the charge density wave (CDW) dynamics along with the pinned acoustic phason mode in the related materials, (TaSe4)2I and K(0.3)MoO3. The measurements cover frequencies from 3 to 700 cm exp -1 and the temperature range from 15 to 300 K. In the niobium-doped alloys, Ta(1-x)Nb(x)(Se4)2I, the size and frequency of the giant infrared mode remain nearly constant as the impurity concentration x is increased. For TaS3, the pinned acoustic phason near 0.5 cm exp -1 dominates epsilon(omega) and an additional small mode lies near 9 cm(exp -1). The latter mode is much smaller than the infrared mode in other CDW materials. These results rule out several models of a 'generic infrared mode' in CDW excitations. They are compared in detail to the predictions of a recent theory attributing the infrared mode to a bound collective mode localized at impurity sites within the crystal. The transmittance of K(0.3)MoO3 has been measured at 1.2 K with a strong dc electric field applied across the crystal. Under these conditions, the charge density wave depins abruptly and carries large currents with near-zero differential resistance. For some samples, the low-frequency transmittance is enhanced slightly when the CDW depins. The magnitude of the oxygen isotope effect in the high-(Tc) superconductor YBa2Cu3O7 has been determined by substitution of O-18 for O-16. A series of cross-exchanges was performed on high-quality polycrystalline specimens to eliminate uncertainties due to sample heat treatments and sample inhomogeneities. DOE

N92-18258# Naval Ocean Systems Center, San Diego, CA.
A REVIEW OF HIGH-TEMPERATURE SUPERCONDUCTIVITY AND THE EFFECT OF CHEMICAL MODIFICATIONS ON Bi2Sr2CaCu2O8 AND Bi2Sr2Ca2Cu3O10
T. E. Jones, W. C. McGinnis, and R. D. Boss Aug. 1991 28 p
(AD-A242314; NOSC-TR-1441) Avail: NTIS HC/MF A03
CSCL 20/2

The aim was to perform chemical modifications to existing materials that may enhance their superconducting properties and provide insight into the mechanisms responsible for high-temperature superconductivity. This report presented a review of high-temperature superconductivity. An overview of superconductivity from its original discovery to the present is also given. Synthesized are two sets of samples. One set was based on the structure Bi2Sr2CaCu2O8 and the other on Bi2-Sr2Ca2Cu3O10. In both cases, the copper was partially replaced with elements from the first transition row of elements. The replacement was at the level of 5 mol. percent of the transition element for copper. The transition elements used were vanadium (V), manganese (Mn), titanium (Ti), nickel (Ni), zinc (Zn), cobalt (Co), and iron (Fe). The effect of the substitutions on the crystal structure was determined. GRA

N92-18262# Los Alamos National Lab., NM.
SPIN SINGLET QUANTUM HALL EFFECT AND NONABELIAN LANDAU-GINZBURG THEORY
A. Balatsky 1991 25 p Presented at the Adriatico Conference on Strongly Correlated Electrons, Trieste, Italy, Aug. 1991
(Contract W-7405-eng-36)
(DE92-003871; LA-UR-91-3717; CONF-9108184-1) Avail: NTIS HC/MF A03

In this paper we present a theory of Singlet Quantum Hall Effect (SQHE). We show that the Halperin-Haldane SQHE wave function can be written in the form of a product of a wave function for charged semions in a magnetic field and a wave function for the Chiral Spin Liquid of neutral spin-(1/2) semions. We introduce a field-theoretic model in which the electron operators are factorized in terms of charged spinless semions (holons) and neutral spin-(1/2) semions (spinons). Broken time reversal symmetry and short ranged spin correlations lead to Su2 (sub kappa = 1) Chern-Simons term in Landau-Ginzburg action for SQHE phase. We construct appropriate coherent states for SQHE phase and show the existence of Su2 valued gauge potential. This potential appears as a result of 'spin rigidity' of the ground state against any displacements of nodes of wave function from positions of the particles and reflects the nontrivial monodromy in the presence of these displacenmants. We argue that topological structure of Su2 (sub kappa = 1) Chern-Simons theory unambiguously dictates semion statistics of spinons. DOE

N92-18263# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
SPECTRA-LUMINESCENCE PROPERTIES OF LASER-ACTIVATED LIQUIDS BASED ON PHOSPHORUS OXICHLORIDE UNDER EXCITATION BY THE NUCLEAR REACTION PRODUCTS
E. A. Seregina, P. P. Dyachenko, and V. V. Kalinin 1990 14 p In RUSSIAN; ENGLISH summary
(DE92-609247; FEI-2085) Avail: NTIS HC/MF A03

The luminescence properties of the inorganic liquids POCl3-SnCl4 activated by Nd(3+);Nd(3+) and (2)UO2; Eu(3+) and Eu(3+) are investigated under excitation by the products of the nuclear reactions in the flow of the fast neutrons. The luminescence photon number distributions in depending on the time or the wavelength are measured by means of the statistical method of the own-photon spectrometry. An energy contribution speed of charged particles emerging in the bulk specimen as a result of neutron interaction with matter has been calculated by the Monte-Carlo method. The efficiency of charged particles energy conversion to luminescence energy has been assessed quantitatively. The effect of sensibilization Nd(3+)-ions by Eu(3+)-ions is observed for the POCl3-SnCl4-Nd(3+)-Eu(3+) system. DOE

N92-18271# North Carolina State Univ., Raleigh. Dept. of Materials Science and Engineering.
GROWTH, NITROGEN VACANCY REDUCTION AND SOLID SOLUTION FORMATION IN CUBIC GaN THIN FILMS AND THE SUBSEQUENT FABRICATION OF SUPERLATTICE STRUCTURES USING AlN AND InN Annual Letter Report, 1 Jan. - 31 Dec. 1991
Robert F. Davis Dec. 1991 80 p
(Contract N00014-86-K-0686)
(AD-A243524) Avail: NTIS HC/MF A05 CSCL 09/1

An atomic layer epitaxy deposition system configured for the growth of thin films of the III-V nitrides of Al, Ga, and In was designed, constructed and commissioned. The system allows the introduction of up to 16 gases without mixing. Self-terminating growth of crystalline GaN films has been achieved on single crystal wafers of (0001) alpha (6H)-SiC. Results of analyses via Auger spectroscopy, electron microscopy, and electron diffraction are described. Deposition of AlN and GaN via gas-source MBE was also continued during this period. The principal emphasis concerned the initial stages of growth of both compounds on the substrates of (00001) alpha (6H)-SiC and (0001) sapphire, as determined using x-ray photoelectron spectroscopy. An initial layer of silicon nitride formed on the surface of SiC prior to the deposition of either nitride. The deposition of GaN on sapphire followed the Stranski-Krastanov mode of nucleation and growth, while on SiC, characteristics of three-dimensional growth were evident. By contrast, AlN grew initially in a layer-by-layer mode. Deposition of GaN on vicinal (100) beta-SiC during UV irradiation resulted in the formation of a new 4H polytype of this material. GRA

N92-18274# Argonne National Lab., IL.
FLUX PINNING BEHAVIOR IN TWIN BOUNDARIES OF SINGLE CRYSTAL YBa2Cu3O(7-DELTA)
W. K. Kwok, S. Fleshler, U. Welp, V. M. Vinokur, J. Downey, and G. W. Crabtree Oct. 1991 7 p Presented at the 4th International Symposium on Superconductivity, Tokyo, Japan, 14-17 Oct. 1991
(Contract W-31-109-eng-38)
(DE92-004124; ANL/CP-74636; CONF-911096-4) Avail: NTIS HC/MF A02

We present magnetoresistance measurements up to H = 6 Tesla using a crossed magnetic field technique to demonstrate pinning by twin boundaries (TB) in YBa2Cu3O(7 - delta). We investigate geometries for H parallel to c parallel to TB, H parallel to ab parallel to TB and for H rotated within a twin boundary plane. We find the critical angle theta* for TB pinning to be field dependent and field independent for H parallel to c parallel to TB and H parallel to ab parallel to TB, respectively, in fields up to 6 Tesla and temperatures near (Tc). In addition, we report on the full phase diagram for the onset of TB pinning. The TB pinning onset temperature coincides with the 'shoulder' feature observed in the resistive transition in magnetic fields in these crystals. DOE

N92-18346# Argonne National Lab., IL.
THE EFFECT OF PROCESSING PARAMETERS DURING HEAT TREATMENT OF BULK HIGH-T(SUB c) SUPERCONDUCTORS
Y. S. Cha, S. E. Dorris, J. R. Hull, and R. B. Poeppel Apr. 1991 32 p Presented at the American Society of Mechanical Engineers (ASME) Annual Winter Meeting, Atlanta, GA, 1-6 Dec. 1991
(Contract W-31-109-eng-38)
(DE92-004149; ANL/CP-72939; CONF-911213-19) Avail: NTIS HC/MF A03

Plastic extrusion is a promising method for producing the long lengths of high-Tc superconductor that will be necessary to meet many potential applications. A crucial phase of the extrusion method is removal of organic constituents. Incomplete removal can leave residual carbon at grain boundaries, which can adversely affect the superconducting properties, whereas excessively rapid removal of the organics can cause the extruded superconductor to disintegrate completely. In this paper, we analyze the effects of the following aspects of organics removal, as they apply to the firing of extruded YBa2Cu3O(x) coils: (1) total pressure in the furnace, (2) oxygen flow, (3) heat conduction, and (4) diffusion of volatile components during removal of organics. DOE

N92-18404# Rochester Univ., NY. Dept. of Physics and Astronomy.
FLUX FLOW, PINNING, AND RESISTIVE BEHAVIOR IN SUPERCONDUCTING NETWORKS
S. Teitel Oct. 1991 15 p
(Contract DE-FG02-89ER-14017)
(DE92-004064; DOE/ER-14017/3) Avail: NTIS HC/MF A03

We have studied the behavior of fluctuation effects in superconducting systems using numerical simulations of XY and Coulomb gas models. Flux flow resistance in two dimensional Josephson junction arrays has been calculated and related to correlations in vortex structure. Randomness has been introduced, and its effects on the superconducting transition and vortex mobility have been studied. We find that randomness destroys phase coherence, yet the randomness induced pinning reduces flux flow resistance at low temperatures. Vortex line fluctuations in high temperature superconductors have been studied using a three dimensional XY model. We have considered the melting of the vortex line lattice, and the entanglement and cutting of vortex lines in the vortex line liquid phase. Vortex line entangling and cutting appear to occur on the same length scales in the liquid phase. The vortex structure function has been calculated and from it, elastic properties of the vortex line liquid have been inferred. The two dimensional classical Coulomb gas, where charges map onto vortices in the superconducting system, has been simulated. The melting transitions of ordered charge (vortex) lattices have been studied, and we find evidence that these transitions do not have the critical behavior expected from standard symmetry analysis. DOE

N92-18412# International Centre for Theoretical Physics, Trieste (Italy).
SQUEEZED STATE OF BIEXCITONS IN EXCITED SEMICONDUCTORS
Ba An Nguyen Jul. 1991 21 p
(DE92-603741; IC-91/201) Avail: NTIS HC/MF A03

Exact time-evolution is analytically derived from a coherent photon-exciton system subjected to a monochromatic radiation field resonant with the exciton-biexciton transition. It is shown that biexcitons, which appear under the resonant pumping, might periodically behave as squeezed quasiparticles, if photons or/and excitons are initially in squeezed states. The squeezing degree of the initial photons or/and excitons, the pumping intensity and the off-resonance detuning are demonstrated to govern the transfer of squeezing from the photon-exciton system to the biexciton. DOE

N92-18424# International Centre for Theoretical Physics, Trieste (Italy).
SEMIEMPIRICAL CALCULATIONS OF THE ELECTRONIC STRUCTURE IN IONIC CRYSTALS
Jiaxin Wang and Liangfeng Wan (Tianjin Univ., China) Dec. 1990 8 p
(DE92-603702; IC-90/436) Avail: NTIS HC/MF A02

Calculations of the electronic structure in ionic crystals with and without defects were performed using the standard molecular orbit CNDO/INDO program for molecular calculation, but some important modifications and parameters optimization have been adopted to be suited to the ionic crystal condition. The calculated results, such as the width of valence bands and band gap, ground levels of perfect ionic crystals and F color center in LIF, are listed and compared with previous results in our knowledge. DOE

N92-18426# International Centre for Theoretical Physics, Trieste (Italy).
DENSITY FUNCTIONAL APPROACH TO PHONON DISPERSION RELATIONS AND ELASTIC CONSTANTS OF HIGH TEMPERATURE CRYSTALS

M. Ferconi and M. P. Tosi Jul. 1991 33 p
(DE92-603739; IC-91/189) Avail: NTIS HC/MF A03

The renormalized phonon frequencies of a monatomic classical crystal at melting are related to the direct correlation functions of its liquid at freezing by means of a functional expansion of the free energy of a suitably deformed crystal around the liquid phase. Expressions for the elastic constants follow by the long-waves method and are compared with earlier results obtained by the homogeneous deformation method. The role of three-body correlations in the functional expansion is discussed, but the illustrative calculations that we present include only the Ornstein-Zernike two-body direct correlation function of the liquid, weighted by a Debye-Waller factor. The Ornstein-Zernike function can be obtained either directly from the measured liquid structure factor or by liquid structure theory in model systems. Our calculations of phonon dispersion relations and elastic constants refer to the bcc metals sodium and potassium, to a Lennard-Jones model for fcc argon, and to the classical one-component plasma crystallized in the bcc and fcc structures. The theoretical results are compared with neutron inelastic scattering and elastic constants data on sodium, potassium and argon, as well as with computer simulation data on the crystallized plasma. DOE

N92-18450# International Centre for Theoretical Physics, Trieste (Italy).
POTENTIAL FLUCTUATIONS DUE TO THE RANDOMLY DISTRIBUTED CHARGES AT THE SEMICONDUCTOR-INSULATOR INTERFACE IN MIS-STRUCTURES
G. Slavcheva and I. Yanchev (Sofia Univ., Bulgaria) Jan. 1991 9 p
(DE92-603735; IC-91/15) Avail: NTIS HC/MF A02

A new expression for the Fourier transform of the binary correlation function of the random potential near the semiconductor-insulator interface is derived. The screening due to the image charge with respect to the metal electrode in MIS-structure is taken into account, introducing an effective insulator thickness. An essential advantage of this correlation function is the finite dispersion of the random potential gamma (exp 2) to which it leads in distinction with the so far known correlation functions leading to divergent dispersion. The important characteristic of the random potential distribution gamma (exp 2) determining the amplitude of the potential fluctuations is calculated. DOE

N92-18452# International Centre for Theoretical Physics, Trieste (Italy).
INFLUENCE OF CHROMIUM 3 IONS ON THE ELECTRICAL PROPERTIES OF NaNH4SO42H2O CRYSTALS
M. E. Kassem, E. F. El-Wahidy, S. Hedewy, H. G. Darwish, and T. Ramadan (Alexandria Univ., Egypt) Jul. 1991 11 p
(DE92-603738; IC-91/186) Avail: NTIS HC/MF A03

The dielectric constant, (epsilon), and electric conductivity, (sigma), of pure and Cr(exp +3) doped samples of NaNH4SO42H2O are measured in the temperature range 20-300 K. The maximum value of dielectric constant in different crystallographic axes is presented and discussed. The effect of foreign ions on the critical behavior and transition temperature T(sub c) is studied. DOE

N92-18453# International Centre for Theoretical Physics, Trieste (Italy).
THE q-DEFORMED SU-2 HEISENBERG MODEL IN 3-DIMENSIONS
Zhongyi Lu and Hong Yan Jul. 1991 24 p
(DE92-603740; IC-91/197; ASITP-91-31) Avail: NTIS HC/MF A03

A q-deformed SU(2) Heisenberg (3-dimensional) spin model is set up, and the q-deformed spin-wave solution is obtained through the q-analogous Holstein-Primakoff transformation. The result is given for small gamma = ln q, which is the quantity characterizing the nonlinearity of the Hamiltonian. A mean-field treatment is arranged to preserved (at least some of) the nonlinearity, and the ordinary ferromagnet ground state is shown as the exact ground state of the new system. Interesting results are obtained for this nonlinear model: (1) There is an energy gap between the ground state and the first excited one, thus the ground state is stable under small perturbation of the background; (2) the specific heat per volume is modified by a small term proportional to the (1/2)-th power of temperature and the square of gamma, which is qualitatively different from the conventional model, and (3) the magnetization M(T) is modified by a factor that depends on gamma. DOE

N92-18454# International Centre for Theoretical Physics, Trieste (Italy).
THEORETICAL CALCULATION OF THE SPECTRA, THE EPR g-FACTORS, AND THE MAGNETIC SUSCEPTIBILITIES OF Cu(2+) ION IN Cs2CuCl4
Wei-Li Shuen Aug. 1991 7 p
(DE92-603742; IC-91/221) Avail: NTIS HC/MF A02

The crystal-field and spin-orbit matrix for d(exp 1) or d(exp 9) configuration with D(sub 2) symmetry has been derived. By diagonalizing the matrix, the energy level of C(exp 2+)(sub u) in Cs2CuCl4 and its eigenfunctions have been obtained with the aid of the approximate SCF d-orbit. Furthermore, by suing the eigenfunctions, the EPR g-factors and the magnetic susceptibilities at different temperatures have been calculated. The calculated results are in good agreement with the experimental findings. The calculation only needs two adjustable parameters and can give more theoretical results than those of previous work which introduced 11 adjustable parameters. DOE

N92-18458# Technische Univ., Eindhoven (Netherlands).
ON SECOND-ORDER SELF-ENERGY CORRECTIONS AND PLASMON RESONANCES IN SILICON Ph.D. Thesis
Roelof Daling 1991 128 p
(ETN-92-90572) Avail: NTIS HC/MF A07

Feynman diagrams and their application to solid state physics are discussed to facilitate understanding. The first and second order self energy diagrams for Si electrons are discussed. The self energy corrections of all skeleton diagrams to the highest valence band state and the lowest conduction band state of silicon at the center of its first Brillouin zone are calculated. Results demonstrate the necessity of introducing a screened interaction if higher order electron-electron interaction effects are to be included in the self energy operator and show that the vertex correction diagram give only a small correction to the direct gap of silicon. The dielectric matrix (eta) of silicon is studied. Basic formulas for random phase approximation are given and some of its properties relevant for its calculation and use in discussion on collective excitations (so called plasmons) are discussed. A method to calculate the complicated IBZ integrals occurring in the expressions for eta is presented. Physically relevant results are discussed and results are compared to existing experimental data. ESA

N92-18463# Technische Univ., Eindhoven (Netherlands).
COMPUTATIONAL STUDIES IN ZEOLITE SCIENCE: AN INVESTIGATION OF GUEST-HOST INTERACTIONS Ph.D. Thesis
Constantinus Johanne denOuden 1991 116 p
(ETN-92-90573) Avail: NTIS HC/MF A06

Molecular phenomena of importance in zeolite catalyst research are studied. The synthesis of zeolites, the modification of catalytic properties of zeolites (ion exchange), and the study of adsorption and diffusion phenomena in zeolites are considered. Theoretical methods of Monte Carlo statistics, molecular dynamics, lattice energy minimization calculation and statistical calculations are combined with experimental work covering pulsed field gradient nuclear magnetic resonance spectroscopy, IR and zeolite synthesis. The following studies are detailed: a method to simulate adsorption in zeolites; the dynamics of the adsorption process; the dynamics of the interaction between occluded template molecules and zeolites in the as-made form after synthesis; and the location of exchanged divalent cations (especially Ni(2+)) in siliceous zeolites. ESA

N92-18489# International Centre for Theoretical Physics, Trieste (Italy).
CRITICAL TEMPERATURES OF TWO PHASE TRANSITIONS IN MIXTURES OF SPHERICAL AND ELLIPSOIDAL MOLECULES
R. Mejdani Jun. 1991 13 p
(DE92-609239; IC-91/99) Avail: NTIS HC/MF A03

In this paper we have derived, in the usual molecular field approximation, an equation for the thermodynamic potential for determining the critical temperatures of two phase transitions in a mixture of ellipsoidal and spherical molecules. These molecules are dispersed on b.c.c.-lattices and their ratio of concentrations is different from 1:1. We have also obtained the bound lines of the orientational and positional transitions in the temperature-concentration diagram for different values of molecular parameters (of ellipsoidal molecules) and interaction parameters. DOE

N92-18490# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
SPECTRA-LUMINESCENCE PROPERTIES OF Nd(3+) IONS UNDER EXCITATION BY NUCLEAR REACTION PRODUCTS IN GaCl3-SOCl2 SYSTEM
E. A. Seregina, P. P. Dyachenko, V. V. Kalinin, O. D. Shevchuk, V. M. Volynkin, and S. A. Markosov 1990 10 p In RUSSIAN; ENGLISH summary
(DE92-609245; FEI-2083) Avail: NTIS HC/MF A02

The luminescence properties of the inorganic liquids GaCl3-SOCl2-Nd3(+) are investigated. The liquids were excited by 14 MeV neutrons. The luminescence photon number distributions, which depend on the time or the wavelength, are measured by using the statistical method of own-photon spectrometry. The contribution energy of the charged particles is calculated as a result of the neutron interaction with matter. The energy conversion efficiency, eta, is dependent upon the ion (Nd3(+)) concentration. DOE

N92-18501# International Centre for Theoretical Physics, Trieste (Italy).
ALLOY MODEL FOR HIGH TEMPERATURE SUPERCONDUCTORS
M. Weissmann and A. Saul (Comision Nacional de Energia Atomica, Buenos Aires, Argentina) Jul. 1991 12 p
(DE92-604006; IC-91/168) Avail: NTIS HC/MF A03

An alloy model is proposed for the electronic structure of high temperature superconductors. It is based on the assumption that holes and extra electrons are localized in small copper oxygen clusters that would be the components of such an alloy. This model, when used together with quantum chemical calculations on small clusters, can explain the structure observed in the experimental densities of states of both hole and electron superconductors close to the Fermi energy. The main point is the strong dependence of the energy level distribution and composition on the number of electrons in a cluster. The alloy model also suggests a way to correlate Tc with the number of holes, or extra electrons, and the number of adequate clusters to locate them. DOE

N92-18502# International Centre for Theoretical Physics, Trieste (Italy).
NONLINEAR FLUCTUATION CONDUCTIVITY OF LAYERED SUPERCONDUCTOR: CROSSOVER IN STRONG ELECTRIC FIELDS
A. A. Varlamov and L. Reggiani Jul. 1991 11 p
(DE92-604007; IC-91/181) Avail: NTIS HC/MF A03

The fluctuation conductivity of a clean layered superconductor is studied in an arbitrary electric field. It is shown that in the vicinity of T(sub c), an unusual crossover from a 3D to a 2D behavior in the nonohmic region of the electric field excess current dependence takes place. In spite of the large size of the fluctuation Cooper pairs here, the strong electric field gives rise to the additional decay of them and to effective freezing of the number of degrees of freedom. DOE

N92-18503# International Centre for Theoretical Physics, Trieste (Italy).
SUPERCONDUCTIVITY AND CHARGE TRANSFER COMPENSATION BY DIRECT DOPING IN THE La(1+x)Ca(y)Ba(2-x-y) Cu3O(7+DELTA) SYSTEM
T. Mertelj, P. Stastny, F. C. Matacotta, P. Ganguly, C. U. Segre, and D. Mihailovic (Nuklearni Inst. Jozef Stefan, Ljubljana, Yugoslavia) May 1991 17 p
(DE92-604011; IC-91/81) Avail: NTIS HC/MF A03

Substitution of La and Ca on the Y and Ba sites in the 1-2-3 structure permits an investigation of charge transfer in the solid solution La(1+x)Ca(y)Ba(2-x-y)Cu3O(7+delta) for doping over a wide compositional range. The superconducting, structural, and optical properties of this system are reported. Changes in the charge balance due to La(+3) substituting on the Ba(+2)-site are compensated by increased oxygen content, and the superconducting properties are maintained over a wide range of x and y due to the presence of Ca. We find that the apex O4 frequency does not exhibit significant frequency shifts which is consistent with the hypothesis that the apex O4 vibration is related to the electronic charge state of the Cu-O planes in the 1-2-3 structure. DOE

N92-18513# Sandia National Labs., Albuquerque, NM.
SIMULATIONS OF LOW-ENERGY ION BOMBARDMENT AND EPITAXIAL GROWTH
E. Chason, P. Bedrossian, J. Y. Tsao, B. W. Dodson, and S. T. Picraux 1991 6 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC04-76DP-00789)
(DE92-004211; SAND-91-1508C; CONF-911202-5) Avail: NTIS HC/MF A02

We have performed computer simulations of epitaxial growth and low-energy ion bombardment for comparison with reflection high-energy electron diffraction (RHEED) measurements. The simulations are based on a hybrid Monte Carlo/rate equation approach which includes the processes of defect creation (adatom and surface vacancy), surface diffusion, and attachment and detachment from steps and islands. In this work, we focus on simulating the experimental observations of ion-induced RHEED oscillations and cancellation of RHEED oscillations during simultaneous ion bombardment and growth. For the interaction of the low-energy ion with the surface, we consider two mechanisms: preferential sputtering (where the sputtering cross-section depends on the atomic coordination) and mobile vacancies. Our results indicate that the primary interaction of the ion beam with the surface is probably through the creation of mobile vacancies, and that the degree of preferential sputtering is not large. DOE

N92-18521# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.
LUMINESCENCE PROPERTIES OF THE INORGANIC LIQUIDS BASED ON SOCl(2)-GaCl(3) ACTIVATED BY NEODYMIUM IN THE PRESENCE OF URANYL UNDER EXCITATION BY NUCLEAR REACTION PRODUCTS
E. A. Seregina, P. P. Dyachenko, V. V. Kalinin, O. D. Shevchuk, I. M. Batyaev, and Yu. A. Kabatskij 1990 6 p In RUSSIAN; ENGLISH summary
(DE92-609246; FEI-2084) Avail: NTIS HC/MF A02

The luminescence properties of the inorganic liquids SOCl2-CaCl3-Nd3(+)-UO2(2+) are investigated. The inorganic liquids were excited by the products of nuclear reactions. These products were in the form of a flow of fast neutrons. The photon number distributions are dependent on the time or the wavelength and are measured by own-photon spectrometry, which is a statistical method. As a result of neutron interaction with matter, the contributed energy of the charged particles is calculated as they emerge from the bulk specimen. The efficiency, eta, of the conversion of the charged particles' energy to luminescence energy has been assessed quantitatively. DOE

N92-18530# International Centre for Theoretical Physics, Trieste (Italy).
STRUCTURE OF MOLTEN YTTRIUM CHLORIDE IN AN IONIC MODEL
G. Pastore (Trieste Univ., Italy), Z. Akdeniz, and M. P. Tosi Jun. 1991 16 p
(DE92-609235; IC-91/123) Avail: NTIS HC/MF A03

We report calculations of the liquid pair structure of YCl3 as a prototype for strongly ionic melts of lanthanide metal trichlorides. The calculations adopt an ionic model involving pair potentials of the Busing type, with parameters for the Y3(+) ion adjusted to the Y - Cl bond length in the YCl3 crystal and to the breathing mode frequency of the (YCl6)(exp -3) octahedral unit. The model is solved in the hypernetted chain approximation and the results are tested against neutron diffraction data on the Faber-Ziman structure factor and the total pair correlation function of molten YCl3. The calculated partial structure factors and pair correlation functions provide insight on the origin and nature of the short-range and intermediate-range order in the melt. DOE

N92-18534# International Centre for Theoretical Physics, Trieste (Italy).
THE EFFECT OF FLUCTUATIONS ON THE HALL EFFECT IN HIGH T(SUB c) SUPERCONDUCTORS, 1
A. A. Varlamov and D. V. Livanov May 1991 8 p
(DE92-604009; IC-91/78) Avail: NTIS HC/MF A02

The effect of superconducting fluctuations on the Hall conductivity of clean layered superconductors at temperatures above critical one is studied. A considerable effect of fluctuations on Hall conductivity for high T(sub c) superconductors on the edge of transition is found to be in agreement with experiment. DOE

N92-18535# International Centre for Theoretical Physics, Trieste (Italy).
THE EFFECT OF FLUCTUATIONS ON THERMOMAGNETIC PHENOMENA IN HIGH T(SUB c) SUPERCONDUCTORS, 2
A. A. Varlamov and D. V. Livanov May 1991 8 p
(DE92-604010; IC-91/79) Avail: NTIS HC/MF A02

The effect of superconducting fluctuations on thermomagnetic coefficients in clean layered superconductors is studied. More singular fluctuation contributions as compared with previous predictions are found. DOE

N92-18540# Kentucky Univ., Lexington. Center for Computational Sciences.
REAL-SPACE MULTIPLE SCATTERING THEORY METHOD: FORMALISM AND APPLICATIONS
X. G. Zhang 1991 10 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-004240; CONF-911202-7) Avail: NTIS HC/MF A02

Different forms of the real-space multiple scattering theory (RS-MST) formalism are compared in order to understand its convergence behavior with respect to truncation in the angular momentum expansions. In particular, the so-called 'folding method' or (1,n) mode is considered, in which the renormalized t-matrix T of the semi-infinite system has the dimension of n (n greater than 1) repeating units and the self-consistent equation for T is constructed by adding and contracting one such unit. It has been demonstrated in previous studies of layered structures that the folding method converges rapidly in both angular momentum (L) and site (n) indices and yields accurate results. The convergence behavior is an important factor to be considered in applying the various forms of the RS-MST method to layered structures as well as other systems with extended defects. DOE

N92-18544# Ames Lab., IA.
RESISTIVITY CHANGES AND GRAIN GROWTH WITH TIME AT ELEVATED TEMPERATURES OF N-TYPE Si80Ge20 WITH AND WITHOUT GaP AND OF P-TYPE Si80Ge20 ALLOYS
M. J. Tschetter and B. J. Beaudry 18 Oct. 1991 9 p Presented at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 13-16 Jan. 1992
(Contract W-7405-eng-82)
(DE92-004648; IS-M-676; CONF-920104-22) Avail: NTIS HC/MF A02

Si80Ge20 alloys containing GaP and P prepared for use in the modular isotopic thermoelectric generator (MOD-RTG) have been monitored continuously for resistivity changes at elevated temperatures for up to three years. Changes in resistivity with time due to dopant precipitation have been considerably slower at 400 C and 500 C than alloys without GaP added. At 600 C and above, changes in resistivity with time are higher in alloys with GaP. Changes in resistivity of p-type Si80Ge20 alloys at the same temperatures agree very well with those reported in the literature. Effects of GaP on grain growth of n-type Si-Ge alloys were also studied at heat treatment temperatures of 1050, 1100, and 1150 C. DOE

N92-18551# Lawrence Livermore National Lab., CA.
PLENUM TYPE CRYSTAL GROWTH CHAMBER Patent Application
K. E. Montgomery, inventor (to DOE) 30 Oct. 1990 8 p
(Contract W-7405-eng-48)
(DE92-003831; US-Patent-Appl-SN-428536;
Patents-US-A7428536) Avail: NTIS HC/MF A02

Crystals are grown in a tank which is divided by a baffle into a crystal growth region above the baffle and a plenum region below the baffle. A turbine blade or stirring wheel is positioned in a turbine tube which extends through the baffle to generate a flow of solution from the crystal growing region to the plenum region. The solution is pressurized as it flows into the plenum region. The pressurized solution flows back to the crystal growing region through return flow tubes extending through the baffle. Growing crystals are positioned near the ends of the return flow tubes to receive a direct flow of solution. DOE

N92-18605# International Centre for Theoretical Physics, Trieste (Italy).
STRUCTURE, GROWTH, AND BONDING NATURE OF Mg CLUSTERS
V. Kumar and R. Car May 1991 47 p
(DE92-603746; IC-91/36) Avail: NTIS HC/MF A03

The structure, growth, and bonding nature of Mg(n) (n=2-13) clusters is studied using the density functional molecular dynamics method and the simulated annealing technique within the local density approximation. We find a tetrahedron and a trigonal prism as two important constituents of the structure of Mg clusters to which atoms can be added by capping the faces. Mg(13) is neither an icosahedron nor a cuboctahedron. The lowest energy structure of Mg(13) that we obtained from our simulated annealing can be considered as fusion of Mg(9) and Mg(4) clusters. This is nearly degenerate with the relaxed hcp structure and suggests the possibility of a path for transition to hcp structure for bigger clusters. We find Mg(4) and Mg(10) to be the magic clusters which is in general agreement with the predictions of the jellium model of metal clusters. However, calculations of the charge densities, the p-character, and the gap between the highest occupied and the lowest unoccupied states suggest presence of mixed bonding character in Mg clusters and an oscillatory and slow convergence to bulk metallic behavior. DOE

N92-18606# International Centre for Theoretical Physics, Trieste (Italy).
ORBITAL KONDO EFFECT DUE TO ASSISTED HOPPING: SUPERCONDUCTIVITY, MASS ENHANCEMENT IN COOPER OXIDES WITH APICAL OXYGEN
A. Zawadowski, K. Penc, and G. Zimanyi (California Univ., Davis.) Jul. 1991 32 p
(DE92-604008; IC-91/188) Avail: NTIS HC/MF A03

Orbital Kondo effect is treated in a model where, in addition to the conduction band, there are localized orbitals with energy not very far from the Fermi energy. If the hopping between the conduction band and the localized heavy orbitals depends on the

occupation of the conduction band orbital, then orbital Kondo correlation occurs. The assisted hopping vertex is enhanced due to the Coulomb interaction between the heavy orbital and the conduction band. The enhanced hopping results in mass enhancement and attractive interaction in the conduction band. The superconductivity transition temperature is calculated. The models of this type can be applied to the high-T(sub c) superconductors where the non-bonding oxygen orbitals of the apical oxygens play the role of heavy orbitals. For an essential range of the parameters, the T(sub c) obtained is about 100K.
DOE

N92-18674# International Centre for Theoretical Physics, Trieste (Italy).
A TRANSFER-MATRIX METHOD FOR SPATIALLY MODULATED STRUCTURES
A. Surda Mar. 1991 28 p
(DE92-603752; IC-91/82) Avail: NTIS HC/MF A03

A cluster transfer-matrix method convenient for calculation of spatially modulated structures of a wide class of lattice-gas models is developed. The method formulates the problem of calculation of the partition function in terms of nonlinear mapping of effective multi-site fields. It is applied to a lattice-gas model qualitatively describing the system of oxygen atoms in the basal planes of high temperature superconductors. The properties of an incommensurate structure occurring at intermediate temperatures are discussed in detail. DOE

N92-18692# International Centre for Theoretical Physics, Trieste (Italy).
EXCITONIC OPTICAL BISTABILITY IN n-TYPE DOPED SEMICONDUCTORS
Nguyen Ba An and Le Thi Cat Tuong Jul. 1991 15 p
(DE92-603810; IC-91/176) Avail: NTIS HC/MF A03

A resonant monochromatic pump laser generates coherent excitons in an n-type doped semiconductor. Both exciton-exciton and exciton-donor interactions come into play. The former interaction can give rise to the appearance of optical bistability which is heavily influenced by the latter one. When optical bistability occurs at a fixed laser frequency both its holding intensity and hysteresis loop size are shown to decrease with increasing donor concentration. Two possibilities are suggested for experimentally determining one of the two parameters of the system: the exciton-donor coupling constant and the donor concentration, if the other parameter is known beforehand. DOE

N92-18697# Sandia National Labs., Albuquerque, NM.
BONDING OF HYDROGEN IMPLANTED AT 80K INTO 3-4 SEMICONDUCTORS
H. J. Stein 1991 6 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC04-76DP-00789)
(DE92-004354; SAND-91-1477C; CONF-911202-6) Avail: NTIS HC/MF A02

Hydrogen implantation at 80 K is shown to introduce As-H centers in GaAs and InAs, and P-H centers in InP. These As(P)-H centers anneal between 150 and 300 K. By analogy to suggested defect assignments in electron irradiated GaAs, it is suggested that the sites for the As(P)-H centers are metastable defects such as close vacancy-interstitial pairs. In contrast to GaAs, where absorption by Ga-H centers increases upon loss of As-H, no absorption attributable to In-H was observed in either InAs or InP. Hydrogen in an As vacancy is the suggested model for Ga-H centers. If such vacancies are thermally unstable in In-based compounds, it would explain an absence of In-H bonds and may reduce the capability for ion implantation to produce electrical isolation in In-based compound semiconductors. DOE

N92-18718# Argonne National Lab., IL.
MAGNETISM OF THIN FILM MULTILAYERS: AN ANALOGUE OF INTERACTING PLATELETS
G. P. Felcher and Y. Y. Huang Nov. 1991 21 p Presented at the NATO Advanced Study Institute Conference, Acquafredda di Maratea, Italy, 11-21 Jun. 1991
(Contract W-31-109-eng-38)
(DE92-004129; ANL/CP-74837; CONF-9106180-2) Avail: NTIS HC/MF A03

Progress is being made toward manufacturing materials with magnetic properties tailored to the desired application. This result is reached in several steps, which are monitored with different optical techniques such as polarized neutron reflectometry. First, ferromagnetic, metallic films (of Fe, Co, Ni, Gd), a few nanometers thick, are prepared by vapor deposition. Their magnetization can be tuned by changing the chemistry of thickness of the films, and can be biased by embedding the films into a matrix of antiferromagnetic material. Ensembles of metallic films (multilayers of superlattices) can be created, with a magnetic coupling between adjacent layers regulated by the nature and thickness of the spacer. For increasing spacer thickness, the alignment of neighboring magnetic layers switches between a parallel (F) and an opposite arrangement (AF) in an oscillatory manner. In multilayer structures possessing more than one kind of magnetic atom, complex magnetic phase diagrams have been predicted to occur, with properties that are strongly influenced by the presence of a surface. With these characteristics, the phenomenology of magnetic multilayers draws a close similarity to the physics of interacting platelets. DOE

N92-18736# Pittsburgh Univ., PA. Dept. of Materials Science and Engineering.
FIM/ATOM PROBE STUDY OF GRAIN BOUNDARIES IN Ni3Al
S. S. Brenner 1991 16 p Presented at the Department of Energy-Basic Energy Sciences (DOE-BES) Workshop on Scientific Issues on Intermetallic Compounds: Status and Forecast for Fundamental Research, La Jolla, CA, 11-14 Sep. 1991
(Contract DE-FG02-85ER-45213)
(DE92-004157; DOE/ER-45213/10; CONF-9109318-1) Avail: NTIS HC/MF A03

Field-ion microscopy and atom probe microanalysis have been used to study grain boundaries in Ni3Al to help clarify the mechanism by which boron ductilizes this material. Except for the Dartmouth material, all of the ductile alloys were grain-refined by cold working and recrystallization at 800-900 C. DOE

N92-18740# Brookhaven National Lab., Upton, NY.
A METHOD OF PRODUCING HIGH QUALITY OXIDE AND RELATED FILMS ON SURFACES
M. W. Ruckman, M. Strongin, and Yongli Gao 1991 12 p Presented at the Technology 2001, San Jose, CA, 3-5 Dec. 1991
(Contract DE-AC02-76CH-00016)
(DE92-005048; BNL-46855; CONF-911231-4) Avail: NTIS HC/MF A03

Aluminum oxide or aluminum nitride films were deposited on MBE grown GaAs(100) using a novel cryogenic-based reactive thin film deposition technique. The process involves the condensation of molecular oxygen, ammonia, or other gases normally used for reactive thin film deposition on the substrate before the metal is deposited. The metal vapor is deposited into this layer and reacts with the molecular solid to form the desired compound or a precursor than can be thermally decomposed to generate the desired compound. The films produced by this method are free of impurities and the low temperatures can be used to control the film and interfacial structure. The process can be easily integrated with existing MBE-systems and on going research using the same apparatus suggests than photon or electron irradiation could also be used to promote the reactions needed to give the intended material. DOE

N92-18762# Massachusetts Univ., Amherst. Dept. of Polymer Science and Engineering.
MACROMOLECULAR CONTROL OF STRUCTURAL ORGANIZATION IN THIN MOLECULAR FILMS: IMPLICATIONS FOR CHEMICAL AND OPTICAL SWITCHING Final Report, 1 Apr. 1988 - 31 Mar. 1991
David A. Tirrell 31 Aug. 1991 9 p

(Contract DAAL03-88-K-0038)
(AD-A244287; ARO-25306.14-CH) Avail: NTIS HC/MF A02
CSCL 07/4

This program was concerned with the development of new ultrathin membranes that respond to well-defined chemical and physical signals. Such membranes are proposed to be useful in applications such as chemical sensing and controlled chemical delivery. The mechanism by which these membranes respond to signals involves changes in the conformation and solvation of surface-bound polyelectrolyte chains. Because polyelectrolytes can be rendered sensitive to many different environmental parameters (e.g., pH, light, ionic strength, etc.) this approach provides a new route to molecular films subject to switching in response to many different (and useful) stimuli. To date, we have prepared membrane systems switchable with pH, temperature, light, glucose concentration, ionic strength, and electrochemical reduction. GRA

N92-18773# Argonne National Lab., IL.
TUNNELING IN CUPRATE AND BISMUTHATE SUPERCONDUCTORS
J. F. Zasadzinski, Qiang Huang, N. Tralshawala (Illinois Inst. of Tech., Chicago.), and K. E. Gray Oct. 1991 12 p Presented at the 5th Annual Conference on Superconductivity and Applications, Buffalo, NY, 24-26 Sep. 1991
(Contract W-31-109-eng-38)
(DE92-004135; ANL/CP-74820; CONF-9109102-4) Avail: NTIS HC/MF A03

Tunneling measurements using a point-contact technique are reported for the following high temperature superconducting oxides: Ba(1-x)K(x)BiO3(BKBO), Nd(2-x)Ce(x)CuO4(NCCO), Bi2Sr2Ca-Cu2O7(BSCCO), and TlBa2CaCu2O(x) (TBCCO). For the bismuthate, BKBO, ideal, S-I-N tunneling characteristics are observed using a Au tip. The normalized conductance is fitted to a BCS density of states and thermal smearing, only proving there is no fundamental limitation in BKBO for device applications. For the cuprates, the normalized conductance displays BCS-like characteristics, but with a broadening larger than from thermal smearing. Energy gap values are presented for each material. For BKBO and NCCO the Eliashberg functions, alpha (exp 2)F omega, obtained from the tunneling are shown to be in good agreement with neutron scattering results. Proximity effect tunneling studies are reported for Au/BSCCO bilayers and show that the energy gap of BSCCO can be observed through Au layers up to 600 Angstroms thick. DOE

N92-18798# California Univ., Berkeley. Lawrence Berkeley Lab.
STRUCTURAL AND INTERFACIAL CHARACTERISTICS OF THIN (LESS THAN 10 nm) SiO2 FILMS GROWN BY ELECTRON CYCLOTRON RESONANCE PLASMA OXIDATION ON (100) Si SUBSTRATES
T. D. Nguyen, D. A. Carl, D. W. Hess, M. A. Lieberman, and R. Gronsky Apr. 1991 12 p Presented at the Spring Meeting of the Materials Research Society (MRS), Anaheim, CA, 29 Apr. - 3 May 1991
(Contracts DE-AC03-76SF-00098; DE-FG03-87ER-13727)
(DE92-004425; LBL-29964; CONF-910406-38) Avail: NTIS HC/MF A03

The feasibility of fabricating ultra-thin SiO2 films on the order of a few nanometer thickness has been demonstrated. SiO2 thin films of approximately 7 nm thickness have been produced by ion flux-controlled electron cyclotron resonance plasma oxidation at low temperature on (100) Si substrates, in reproducible fashion. Electrical measurements of these films indicate that they have characteristics comparable to those of thermally grown oxides. The thickness of the films was determined by ellipsometry, and further confirmed by cross-sectional high-resolution transmission electron microscopy. A comparison between the ECR and the thermal oxide films shows that the ECR films are uniform and continuous over at least a few microns in lateral direction, similar to the thermal oxide films grown at comparable thickness. In addition, HRTEM images reveal a thin (1-1.5 nm) crystalline interfacial layer between the ECR film and the (100) substrates. Thinner oxide films of approximately 5 nm thickness have also been attempted but, so far, have resulted in nonuniform coverage. Reproducibility at this thickness is difficult to achieve. DOE

N92-18820# University of Southern California, Los Angeles. Dept. of Materials Science and Engineering.
KINETIC ASPECTS OF LATTICE MISMATCH IN MOLECULAR BEAM EPITAXIAL GROWTH ON PLANAR AND PATTERNED SUBSTRATES Annual Technical Report, 1 Feb. 1990 - 31 Jan. 1991
A. Madhukar 20 Jun. 1991 33 p
(Grant AF-AFOSR-0184-90)
(AD-A244291; AFOSR-91-1011TR) Avail: NTIS HC/MF A03
CSCL 20/12

This work focuses on examining the nature of the molecular beam epitaxial growth process, its control and optimization, achieving defect reduction via growth on prepatterned substrates, and the behavior of some optical and transport characteristics for strained system using InGaAs/AlGaAs as the vehicle. Highlights include: (1) the first demonstration of GaAs(111)B homoepitaxy free of twins and with mirror-like surfaces through usage of real-time reflection electron diffraction intensity behavior; (2) demonstration of the presence of strain in the substrate to unexpectedly large depths below 3D islands of InGaAs; (3) presence of atomic relaxation in coherent islands; (4) the tendency for defect introduction at island edges beyond a critical size; (5) realization of strained InGaAs/AlAs resonant tunnelling diodes with room temperature peak currents approximately 125 kAmp/sq cm and peak-to-valley ratios of 5:1; (6) defect reduction via strain relief at mesa edges in growth on prepatterned mesas; (7) realization of good electroabsorption in thick (1 to 2 microns) strained multiple quantum wells; (8) dielectric encapsulation induced strain shifts; and (9) rapid thermal annealing induced intermixing of components at interfaces and the resulting changes in the nature of the quantum well potential. GRA

N92-18824# Oklahoma State Univ., Stillwater. Center for Laser Research.
PUMP WAVELENGTH TUNING OF NEAR INFRARED OPTICAL PARAMETRIC Interim Report
Mehendra G. Jani, Richard G. Powell, Bahaeddin Jassemnejad, and Richard Stolzenberger 23 Sep. 1991 11 p
(Contract DAAL03-91-G-0099)
(AD-A244304; ARO-28472.1-PH) Avail: NTIS HC/MF A03
CSCL 20/12

Optical parametric conversion in a potassium titanyl phosphate crystal (KTP) using a tunable alexandrite laser was investigated as a function of pump wavelengths in the 700-800 nm region. Threshold energies and slope efficiencies for a doubly resonant oscillator configuration were measured for pump wavelengths of 744 nm, 766 nm, and 780 nm. A theoretical analysis using Sellmeier's equations and phase matching conditions provide good agreement with experimentally measured values of signal and idler wavelengths as a function of the pump wavelengths. GRA

N92-18845# Northwestern Univ., Evanston, IL.
DEFECT STRUCTURE OF SEMICONDUCTING AND INSULATING EPITAXIAL OXIDES
B. W. Wessels 1991 3 p
(Contract DE-FG02-85ER-45209)
(DE92-005080; DOE/ER-45209/6) Avail: NTIS HC/MF A01

The study of the defect structure of semiconducting and insulating epitaxial oxides has continued. During this period, the growth and characterization of epitaxial BaTiO3 and SrTiO3 layers were undertaken. For the growth of the epitaxial oxides, an organometallic chemical vapor deposition technique was developed. For the deposition of BaTiO3, we developed and used the second generation Ba precursor, barium (hexafluoro-acetylacetonate)2 (tetraglyme)(Ba(hfa)2 (single bond) tet) along with titanium tetraisoproxide as the titanium precursor. Recently, we have succeeded in depositing epitaxial BaTiO3 by using single crystalline LaAlO3 substrates. This development should

significantly improve our electronic property and defect structure measurements since grain boundaries are eliminated in the layers. The structure of the epitaxial BaTiO3 was examined using both x ray diffractometer measurements and high resolution transmission electron microscopy (HRTEM). DOE

N92-18849# Oak Ridge National Lab., TN.
DISTRIBUTION AND CHARACTERIZATION OF IRON IN IMPLANTED SILICON CARBIDE
J. Bentley, L. J. Romana, L. L. Horton, and C. J. McHargue (Tennessee Univ., Knoxville.) 1991 6 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract DE-AC05-84OR-21400)
(DE92-005126; CONF-911202-14) Avail: NTIS HC/MF A02

Analytical electron microscopy (AEM) and Rutherford backscattering spectroscopy-ion channeling (RBS-C) have been used to characterize single crystal alpha-silicon carbide implanted at room temperature with 160 keV Fe-57 ions to fluences of 1, 3, and 6 x 10(exp 16) ions/sq cm. Best correlations among AEM, RBS, and TRIM calculations were obtained assuming a density of the amorphized implanted regions equal to that of crystalline SiC. No iron-rich precipitates or clusters were detected by AEM. Inspection of the electron energy loss fine structure for iron in the implanted specimens suggests that the iron is not metallically bonded, supporting conclusions from earlier conversion electron Moessbauer spectroscopy (CEMS) studies. In-situ annealing surprisingly resulted in crystallization at 600 C with some redistribution of the implanted iron. DOE

N92-18854# Argonne National Lab., IL.
INTERDIFFUSION AND GRAIN-BOUNDARY MIGRATION IN Au-Cu BILAYERS DURING ION-IRRADIATION
D. E. Alexander, L. E. Rehn, and P. M. Baldo Nov. 1991 7 p Presented at the Annual Fall Meeting of the Materials Research Society, Boston, MA, 2-6 Dec. 1991
(Contract W-31-109-eng-38)
(DE92-005238; ANL/CP-73625; CONF-911202-19) Avail: NTIS HC/MF A02

Ion irradiation and annealing experiments have been conducted on Au/Cu bilayer films to evaluate the effect of irradiation on diffusion-induced grain boundary migration (DIGM). The Au films were prepared with a large grained microstructure with grain boundaries perpendicular to the film surface and extending through the film thickness. Irradiations were conducted with 1.5 MeV Kr at 228 C. Rutherford backscattering spectrometry of the samples revealed that interdiffusion was substantially enhanced in the irradiated area relative to the unirradiated area. Both irradiated and annealed-only areas were characterized by a nearly uniform composition of 14 and 7 at. pcts. Cu respectively through the entire thickness of the underlying Au film. Small probe X ray energy dispersive spectroscopy showed significant lateral compositional homogeneities in both irradiated and annealed areas. These two results are consistent with previous observations of DIGM in the Au/Cu system, suggesting that this previously unexamined mechanism contributes to ion beam mixing. DOE

N92-18869# Massachusetts Inst. of Tech., Cambridge. Materials Processing Center.
ELECTROCHEMICALLY MODULATED SUPERCONDUCTIVITY Final Technical Report, 1 Mar. 1990 - 31 Aug. 1991
Donald R. Sadoway and Robert M. Rose 26 Nov. 1991 22 p
(Contract N00014-90-J-1722)
(AD-A244386) Avail: NTIS HC/MF A03 CSCL 07/4

The goal of this project was to test the feasibility of electrochemically modulated superconductivity in the cuprate superconductors. Such a test is possible because the new high temperature superconductors are ionic solids that are extremely sensitive to oxygen potential. Passive optimization of the latter is impossible, not only due to materials processing limitations but also due to thermodynamic and structural instabilities. Our approach is active intervention by electrochemical means, in other words, electrochemical polarization while the material is actually or potentially in the superconducting state. This requires electrolytes that are functional at cryogenic temperatures. Several years ago we discovered cryogenic electrolysis and demonstrated the existence of such remarkable media. Success in this effort would make possible a new class of electronic and photonic devices that exploit the capability to control actively the transition into and out of the superconducting state while the material is in service. A cuprate-based superconductor is polarized electrochemically in a cryogenic electrolyte while the electrical resistivity is measured simultaneously. GRA

N92-18875# State Univ. of New York, Buffalo. Dept. of Physics.
X RAY ABSORPTION STUDIES OF HIGH TRANSITION TEMPERATURE SUPERCONDUCTORS Final Technical Report, 1 Jan. 1988 - 31 Jul. 1991
Yi-Han Kao 30 Sep. 1991 16 p
(Grant AF-AFOSR-0095-88; AF Proj. 2306)
(AD-A244413; AFOSR-91-1024TR) Avail: NTIS HC/MF A03 CSCL 20/12

Several new experimental techniques were used for a comprehensive study of the microstructures and physical properties of high transition-temperature superconductors. This research made extensive use of synchrotron radiation which allowed many unique ways to nondestructively probe the short-range-order structure in superconductors. In addition, some novel methods were used to investigate the effects of chemical doping and transport as well as magnetic properties of thin films of superconducting materials prepared by laser ablation. GRA

N92-18883# International Centre for Theoretical Physics, Trieste (Italy).
ELIASHBERG THEORY APPLIED TO THE STUDY OF AN Nb-Ge SERIES
R. Baquero, J. Gutierrez-Ibarra, and K. E. Kihlstrom (Westmont Coll., Santa Barbara, CA.) Jul. 1991 41 p
(DE92-609666; IC-91/155) Avail: NTIS HC/MF A03

We use the strong coupling theory of superconductivity to perform a detailed analysis of the Eliashberg functions alpha(exp 2)F(omega), for thirteen samples of Nb-Ge with critical temperatures ranging from 7.0 to 21.1 K. As critical temperature increases, we analyze the general trends of the electron-phonon coupling parameter lambda, of the integral of alpha(exp 2)F(omega)'A', and of other characteristics of alpha(exp 2)F(omega) on the basis of empirical criteria. While we find that the samples have in general the behavior expected, a closer analysis points to an overall attenuation in alpha(exp 2)F(omega) of unclear origin. Though the gap edge, (delta)0, appears to be well described by the (alpha)(exp 2)F(omega) obtained, the thermodynamic critical field agrees poorly with that reproduced by alpha(exp 2)F(omega) in the only case where the necessary (tunneling alpha(sup 2)F(omega) critical field measurements) data are available. Our analysis suggests there is a gross uncertainty in the measured H(sub c)(0). The overall analysis shows that the samples obtained are of enough quality to already give meaningful results upon inversion of the tunneling data. DOE

N92-18888# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
THE MUON SPIN ROTATION INVESTIGATION OF MULTI-PHASE Bi-BASED SUPERCONDUCTORS
V. G. Grebinnik, V. N. Duginov, and V. A. Zhukov 1990 7 p Presented at the 5th International Conference on Muon Spin Rotation, Relaxation, and Resonance, Oxford, England, 9-12 Apr. 1990
(DE92-604012; JINR-E-14-90-279) Avail: NTIS HC/MF A02

The muon depolarization rate (sigma) was measured in the ceramic Bi-Sr-Ca-Cu-O samples with various contents of the 80 and 110 K phases. The values of sigma (obtained by a standard FC technique in the external fields of 0.04, 0.08, and 0.2 T and in the temperature region 10-300 K) were used for estimation of the magnetic penetration depths perpendicular to the basal plane: (1) for the 80 K phase - lambda sub parallel (T approaching 0 K) =

2300 +/- 100 A (lambda(sub eff) (T approaching 0 K) = 2830 +/- 130 A); and (2) for the 110 K phase - lambda sub parallel (T approaching 0 K) = 2030 +/- 100 A (lambda(sub eff) (T approaching 0 K) = 2500 +/- 130 A). DOE

77 THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics.

For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

N92-18016# International Centre for Theoretical Physics, Trieste (Italy).
THE EMBEDDING OF SUPERSYMMETRY INTO THE DYNAMICAL GROUPS
A. O. Barut and P. Roy Jun. 1991 9 p
(DE92-609163; IC-91/98) Avail: NTIS HC/MF A02

The supersymmetry as applied to ordinary quantum mechanical systems is shown to represent a substructure inside the more general framework of dynamical groups. Its possible generalization and the related concepts of shape invariance and Darboux transformations are discussed. DOE

N92-18018# International Centre for Theoretical Physics, Trieste (Italy).
THE SQUARE ISING MODEL WITH SECOND-NEIGHBOR INTERACTIONS AND THE ISING CHAIN IN A TRANSVERSE FIELD
M. D. Grynberg and B. Tanatar Jun. 1991 24 p
(DE92-609232; IC-91/105) Avail: NTIS HC/MF A03

We consider the thermal and critical behavior of the square Ising lattice with frustrated first- and second-neighbor interactions. A low-temperature domain wall analysis including kinks and dislocations shows that there is a close relation between this classical model and the Hamiltonian of an Ising chain in a transverse field, provided that the ratio of the next-nearest to nearest-neighbor coupling, is close to 1/2. Due to the field inversion symmetry of the Ising chain Hamiltonian, the thermal properties of the classical system are symmetrical with respect to this coupling ratio. In the neighborhood of this regime, critical exponents of the model turn out to belong to the Ising universality class. Our results are compared with previous Monte Carlo simulations. DOE

N92-18030# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
CHARGE-ASYMMETRICAL PARASTATISTICS
A. B. Govorkov 1990 18 p Submitted for publication
(DE92-609097; JINR-E-2-90-28) Avail: NTIS HC/MF A03

A new scheme of generalized quantization obeying all general requirements of the local quantum (free) field theory is considered. In contrast with the Green paraquantization, this one turns out to be C-noninvariant: the number of antiparticles can exceed the number of particles in a system not more than unity (the number of particles in a system is not limited). DOE

N92-18033# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
PATH INTEGRAL FOR THE YANG-MILLS THEORY IN A NONPERTURBATIVE REGION
S. V. Shabanov 1990 16 p Submitted for publication
(DE92-609102; JINR-E-2-90-402) Avail: NTIS HC/MF A03

The choice of physical variables in gauge theories is discussed. It is shown that the quantum description is independent of the choice of physical degrees of freedom if physical variables are considered curvilinear in the path integral approach. Then, the conventional path integral with a gauge condition is modified. The found path integral is used for the quantum description of the Yang-Mills fields with an ambiguous gauge (Gribov's problem). DOE

N92-18034# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
DIVERGENT POTENTIALS IN MULTIPOLE QUANTUM ELECTRODYNAMICS
M. I. Shirokov 1990 14 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE92-609103; JINR-R-4-90-404) Avail: NTIS HC/MF A03

The multiple form of quantum electrodynamics containing the interaction eq-vector x E-vector is discussed. Its hamiltonian has a divergent operator term. The available treatment of the trouble seems unsatisfactory. A potential-like nature of the term is ascertained using a regularization. A generalization of the multipole form is suggested in which the term divergency is reduced. It is shown that the obtained interaction with photons is still equal to eq-vector x E-vector in the dipole approximation, and interatomic Coulomb interactions are absent. DOE

N92-18064# International Centre for Theoretical Physics, Trieste (Italy).
PERTURBATIVE ANALYSES IN TWO DIMENSIONAL GRAVITY
F. D. Mazzitelli and N. Mohammedi Jun. 1991 13 p
(DE92-609088; IC-91/107) Avail: NTIS HC/MF A03

A generalized action for two dimensional quantum gravity is considered. This includes, in addition to the Einstein-Hilbert action near two dimensions, a term imposing the constancy of the scalar curvature R. The propagators have no poles in epsilon (d = 2 - epsilon) and the theory can be made on-shell finite by tuning some parameters. We argue that the anomalous dimensions of certain operators do not get renormalised. This is in agreement with the exact solution of the Liouville theory supplemented with a constraint expressing the constancy of R. DOE

N92-18065# International Centre for Theoretical Physics, Trieste (Italy).
ZERO CURVATURE CONDITION OF OSp(2/2) AND THE ASSOCIATED SUPERGRAVITY THEORY
A. Das, Wen-Jui Huang, and S. Roy (Rochester Univ., NY.) Jun. 1991 27 p
(DE92-609091; IC-91/125; UR-1215; ER-13065-667) Avail: NTIS HC/MF A03

The N = 2 fermionic extensions of the KdV equations are derived from the zero curvature condition associated with the graded Lie algebra of OSp(2/2). These equations lead to two bi-Hamiltonian systems, one of which is supersymmetric. We also derive the one-parameter family of N = 2 supersymmetric KdV equation without a bi-Hamiltonian structure in this approach. Following our earlier proposal, we interpret the zero curvature condition as a gauge anomaly equation which brings out the underlying current algebra for the corresponding 2D-supergravity theory. This current algebra is, then, used to obtain the operator product expansions of various fields of this theory. DOE

N92-18133# International Centre for Theoretical Physics, Trieste (Italy).
QUANTUM MECHANICS ON THE CIRCLE AND W(1 + INFINITY)
R. Floreanini, R. Percacci (International School for Advanced Studies, Trieste, Italy), and E. Sezgin Aug. 1991 7 p
(DE92-609052; IC-91/205; CTP-TAMU-53/91; ISAS-114/91/EP) Avail: NTIS HC/MF A02

The algebra W sub 1+ infinity, with central charge c = 0, can be identified with the algebra of quantum observables of a particle moving on a circle. Mathematically, it is the universal enveloping algebra of the Euclidean algebra in two dimensions. Similarly, the super-W sub infinity algebra is found to be the universal enveloping algebra of the super-Euclidean algebra in two dimensions. DOE

N92-18135# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation.
FUNCTIONAL INTEGRAL IN SUPERSYMMETRIC QUANTUM MECHANICS
D. V. Ktitarev 1990 5 p Submitted for publication
(DE92-609055; JINR-E-5-90-12) Avail: NTIS HC/MF A01

The solution of the square root of the Schroedinger equation for the supersymmetric quantum mechanics is expressed in the form of series. The formula may be considered as a functional integral of the chronological exponent of the super-pseudodifferential operator symbol over the superspace. DOE

N92-18148# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
HOW QUANTUM IMPENETRABILITY AFFECTS AHARONOV-BOHM SCATTERING?
G. N. Afanasev and V. M. Shilov 1990 26 p In RUSSIAN; ENGLISH summary Submitted for publication
(DE92-609058; JINR-R-4-90-178) Avail: NTIS HC/MF A03

It is shown that different forms of quantum impenetrability lead to different physical consequences. This should be kept in mind in analyzing experimental data. The relativistic impenetrability conditions are considered and the corresponding relativistic Aharonov-Bohm cross-sections are obtained. The possibility of the AB effect occurrence in simply-connected space regions is discussed. DOE

N92-18151# International Centre for Theoretical Physics, Trieste (Italy).
AXION VERSUS DOMAIN WALLS BOUNDED BY COSMIC STRINGS
G. R. Dvali Jun. 1991 11 p
(DE92-609087; IC-91/103) Avail: NTIS HC/MF A03

It is shown that two possible schemes of string bounded domain wall formation are closely related. Walls can be avoided if a certain type of couplings between scalars, responsible for string and wall formation, are excluded from the potential. This enlarges the continuous global symmetry of the model which, being broken, instead of domain walls gives rise to global strings and goldstone bosons. A realistic example of spontaneously broken family symmetry is considered. It is shown that the existence of the axion in the model with local chiral flavor symmetry SU(3) sub H, can solve the domain wall problem. DOE

N92-18161# International Centre for Theoretical Physics, Trieste (Italy).
HIGHER GENUS STRING CORRECTIONS TO GAUGE COUPLINGS
I. Antoniadis, T. R. Taylor (Northeastern Univ., Boston, MA.), and K. S. Narain Jun. 1991 20 p
(DE92-609090; IC-91/124; NUB-3025; CPTH-A050-0491) Avail: NTIS HC/MF A03

Dependence of the gauge couplings on the moduli of the compactified space is studied for orbifold compactifications of the heterotic superstring. It is shown that such dependence is possible only for theories with sectors preserving N = 2 spacetime supersymmetry, and it satisfies a non-renormalization theorem. Namely, it is given entirely at the one-loop level and is determined by the violation of the integrability of 0-angle with respect to the moduli. DOE

N92-18163# International Centre for Theoretical Physics, Trieste (Italy).
REDUCTION OF THE DIRAC EQUATION AND RELATION WITH THE IVANENKO-LANDAU-KAEHLER EQUATION
Yu. N. Obukhov (Moscow State Univ., USSR) and S. N. Solodukhin Jul. 1991 29 p
(DE92-609094; IC-91/147) Avail: NTIS HC/MF A03

We consider the spinor theory within the framework of the inhomogeneous differential forms formalism. We also consider the possibility of describing fermions with the help of the Ivanenko-Landau-Kaehler equation. The relations between these two equations are studied. DOE

N92-18164# International Centre for Theoretical Physics, Trieste (Italy).
STATIC PLANE SYMMETRIC SPACETIMES
A. Qadir and M. Ziad (Quaid-i-Azam Univ., Islamabad, Pakistan) Jun. 1991 4 p
(DE92-609095; IC-91/158) Avail: NTIS HC/MF A01

A complete classification of static plane symmetric spacetimes is provided. The previously known spacetimes are recovered (but not generally discussed) and some new spacetimes with higher symmetry found. DOE

N92-18371# International Centre for Theoretical Physics, Trieste (Italy).
ON CALCULATIONS OF THE GROUND STATE ENERGY IN QUANTUM MECHANICS
G. V. Efimov Feb. 1991 30 p
(DE92-603630; IC-91/31) Avail: NTIS HC/MF A03

In nonrelativistic quantum mechanics the Wick-ordering method called the oscillator representation suggested to calculate the ground-state energy for a wide class of potentials allowing the existence of a bound state. The following examples are considered: the orbital excitations of the ground-state in the Coulomb plus linear potential; the Schroedinger equation with a 'relativistic' kinetic energy, sq. root of (p(exp 2) + m(exp 2)); and the Coulomb three-body problem. DOE

N92-18373# International Centre for Theoretical Physics, Trieste (Italy).
PATH INTEGRAL QUANTIZATION OF THE MAGNETIC TOP
A. O. Barut and I. H. Duru Jun. 1991 6 p
(DE92-603633; IC-91/96) Avail: NTIS HC/MF A02

The magnetic top which is a realistic canonical model for quantum spin is quantized here by path integral methods. We determine the propagator and the wave functions in the space of Euler angles. DOE

N92-18376# International Centre for Theoretical Physics, Trieste (Italy).
TOWARDS A TENSOR CALCULUS FOR KAPPA-SUPERSYMMETRY
E. A. Ivanov and A. A. Kapustnikov May 1991 12 p
(DE92-603668; IC-91/68) Avail: NTIS HC/MF A03

We present a new manifestly space-time and world-volume supersymmetric formulation of the simplest super p-branes, massive d = 2, N = 1 superparticle and d = 4, N = 1 superstring, in terms of properly constrained world-line and world-sheet superfields. We identify the relevant kappa-supersymmetries with a kind of local supersymmetry in the world-volume superspaces and, based on this, develop a tensor calculus for constructing higher-order supersymmetric and kappa-invariant corrections to the corresponding minimal super p-brane actions. The latter are represented by pure Wess-Zumino terms in the world-volume superspaces. A 'double analyticity' principle for extending this superfield approach to other super p-branes is suggested. DOE

N92-18377# International Centre for Theoretical Physics, Trieste (Italy).
FEYNMAN PATH INTEGRAL FOR THE DIRAC EQUATION IN A CURVED SPACE-TIME
Z. Turakulov Jun. 1991 8 p
(DE92-603670; IC-91/80) Avail: NTIS HC/MF A02

Internal angular momentum of a spinning test-particle moving in a curved space-time obeys the law of parallel transport along the particle world line. Therefore, the final spin orientation depends on the world line. Assuming that propagator of a quantum particle is formed by contributions of all its world lines, every one of which possesses some amplitude, one can see that these amplitudes actually pertain to the particle final spin states. Consequently, the law of parallel transport for spin must be taken into account in definition of world line amplitudes. In this work, such amplitudes are constructed for massive spin 1/2 particles. It is shown that path integral for such a particle takes the form of a Clifford algebra-valued two-point function. DOE

N92-18378# International Centre for Theoretical Physics, Trieste (Italy).
NONABELIAN N = 2 SUPERSTRINGS: HAMILTONIAN STRUCTURE
A. P. Isaev and E. A. Ivanov Apr. 1991 18 p
(DE92-603671; IC-91/86) Avail: NTIS HC/MF A03

We examine the Hamiltonian structure of nonabelian N = 2 superstring models which are the supergroup manifold extensions of N = 2 Green-Schwarz superstring. We find the Kac-Moody and Virasoro type superalgebras of the relevant constraints and present elements of the corresponding quantum theory. A comparison with the type 2A Green-Schwarz superstring moving in a general curved 10-d supergravity background is also given. We find that nonabelian superstrings (for d = 10) present a particular case of this general system corresponding to a special choice of the background. DOE

N92-18384# International Centre for Theoretical Physics, Trieste (Italy).
FRACTAL NATURE OF TIME: PROPOSAL FOR NEW EXPERIMENTS
I. Khan Aug. 1991 29 p
(DE92-603648; IC-91/207) Avail: NTIS HC/MF A03

For uniform rectilinear motion a careful formulation of the notion of equivalence gives the usual result of special relativity for the behavior of a radially moving clock. Application of the same procedure to uniform circular motion gives results for the behavior of non-radially moving clocks which differ from those of special relativity, are independent of the radius of circular motion and which cannot be ruled out on the basis of present experiments. New experiments testing the theory of special relativity are proposed. It is shown that the rate of a clock depends not only on its velocity but also on the angle between its direction of motion and its direction relative to the observer. Furthermore, the measure of the time interval between two light pulses which are intercepted and re-emitted immediately along the common original direction of propagation behaves in a fractal-like manner. DOE

N92-18385# International Centre for Theoretical Physics, Trieste (Italy).
CANONICAL DESCRIPTION OF A TWO-DIMENSIONAL GRAVITY
K. G. Akdeniz, O. F. Dayi, and A. Kizilersu Aug. 1991 10 p
(DE92-603650; IC-91/216) Avail: NTIS HC/MF A02

A two-dimensional gravity theory which was studied before within Lagrangian methods, in the conformal gauge is investigated in terms of Hamiltonian methods. Although the reparameterization invariant and the conformal gauge fixed Lagrangians lead to a different number of physical degrees of freedom, it is shown that on mass-shell they are equivalent. DOE

N92-18386# International Centre for Theoretical Physics, Trieste (Italy).
NONRENORMALIZABILITY OF THE MASSIVE N=2 SUPER-YANG-MILLS THEORY
G. A. Khelashvili (Joint Inst. for Nuclear Research, Dubna, USSR) and V. I. Ogievetsky Feb. 1991 11 p
(DE92-603660; IC-91/28) Avail: NTIS HC/MF A03

The massive N = 2 supersymmetric Yang-Mills theory is investigated. We used the Stueckelberg formalism in the N = 2 harmonic superspace approach. It is proved that the renormalizability is violated starting from the g(sup 4) order of perturbation theory. The Stueckelberg fields are shown to form a nonlinear sigma-model. That sigma-model is nonrenormalizable itself. DOE

N92-18396# International Centre for Theoretical Physics, Trieste (Italy).
QUANTUM MECHANICS PARADOXES AT THE PHI-FACTORY
G. C. Ghirardi, R. Grassi, and T. Weber Apr. 1991 26 p
(DE92-603631; IC-91/65) Avail: NTIS HC/MF A03

We discuss the possibility of performing experiments allowing one to test quantum mechanics versus any local realistic model within the context of the physics at the phi-factory. After having sketched the main features of the physical process under consideration and having focused the locality requirements for it, we derive Bell's inequality for the two-meson system. Comparison with quantum predictions shows that the inequality is not violated for any choice of the parameters characterizing the measurement process. Contrary to the case of spin variables, there is then no way to exclude, by experiments at the phi-factory, the possibility of a local realistic description of the process. A recent suggestion about a test of quantum predictions versus the assumption of a spontaneous factorization mechanism, as well as the claimed validity of an inequality which is different from Bell's one, are also discussed. The general conclusion is that the phi-factory facility does not seem to open new ways of testing quantum mechanics versus alternative general schemes of the type which are usually regarded as worth considering the debate about locality and quantum mechanics. The concluding section is devoted to making clear our position with respect to the problems discussed. It is pointed out that, in our opinion, the existing experimental evidence makes already clear that one has to accept the 'mysterious' features of microscopic systems. The really crucial problem is that of investigating whether one can restore a coherent worldview which generally conforms with our experience at the macroscopic level, by keeping all highly successful predictions of quantum theory at the microscopic one. DOE

N92-18397# Melbourne Univ., Parkville (Australia). School of Physics.
A NEW FORMULATION OF THE THEORY OF TACHYONS. PART 2: TACHYON ELECTRODYNAMICS
R. L. Dawe and K. C. Hines Jun. 1991 107 p
(DE92-603637; UM-P-91/35) Avail: NTIS HC/MF A06

A new formulation of the theory of tachyons using the same two postulates as in special relativity is applied to electrodynamics. Use is made of a 'switching principle' to show how tachyons automatically obey the law of conservation of electric charge in any inertial reference frame, even though the observed electric charge is not any invariant for tachyons. Tachyonic transformations of electromagnetic fields E, B, D, H, P, and M are rigorously derived from Maxwell's equations and are shown to be the same as for bradyonic transformations. Tachyonic transformations of current and charge densities and scalar and vector potentials are also derived and discussed. Further examples include calculations of the magnetic dipole moment of a tachyonic current loop and of the speed of light in a tachyonic dielectric. Constitutive equations for a tachyonic dielectric are also given. The Lagrangian and Hamiltonian for charged tachyons are discussed, as well as generic tachyonic transformations. DOE

N92-18398# Melbourne Univ., Parkville (Australia). School of Physics.
ON QUANTIZATION, THE GENERALISED SCHROEDINGER EQUATION AND CLASSICAL MECHANICS
Kingsley R. W. Jones Jun. 1991 8 p
(DE92-603638; UM-P-91/45) Avail: NTIS HC/MF A02

A psi-dependent linear functional operator, was defined, which solves the problem of quantization in non-relativistic quantum mechanics. Weyl ordering is implemented automatically and permits derivation of many of the quantum to classical correspondences. The parameter lambda presents a natural C(sup infinity) deformation of the dynamical structure of quantum mechanics via a nonlinear integro-differential 'Generalized Schroedinger Equation', admitting an infinite family of soliton solutions. All these solutions are presented and it is shown that this equation gives an exact dynamic and energetic reproduction of classical mechanics with the correct measurement theoretic limit. DOE

N92-18399# International Centre for Theoretical Physics, Trieste (Italy).
A TOPOLOGICAL MODEL FOR TWO-DIMENSIONAL GRAVITY COUPLED TO MATTER
L. F. Cugliandolo, F. A. Schaposnik, and H. Vucetich Jul. 1991

31 p
(DE92-603647; IC-91/184) Avail: NTIS HC/MF A03

Starting from a topological gauge theory in two dimensions with symmetry groups ISO(2,1), SO(2,1), and SO(1,2), we construct a model for gravity with non-trivial coupling to matter. We discuss the equations of motion which are connected to those of previous related models but incorporate matter content. We also discuss the resulting quantum theory and finally present explicit formulae for topological invariants. DOE

N92-18401# International Centre for Theoretical Physics, Trieste (Italy).
RELATIVISTIC MODEL FOR STATEVECTOR REDUCTION
P. Pearle Apr. 1991 50 p
(DE92-603669; IC-91/74) Avail: NTIS HC/MF A03

A relativistic quantum field model describing statevector reduction for fermion states is presented. The time evolution of the states is governed by a Schroedinger equation with a Hamiltonian that has a Hermitian and a non-Hermitian part. In addition to the fermions, the Hermitian part describes positive and negative energy mesons of equal mass, analogous to the longitudinal and timelike photons of electromagnetism. The meson-field-sum is coupled to the fermion field. This 'dresses' each fermion so that, in the extreme nonrelativistic limit (non-moving fermions), a fermion in a position eigenstate is also in an eigenstate of the meson-field-difference with the Yukawa-potential as eigenvalue. However, the fermions do not interact: this is a theory of free dressed fermions. It is possible to obtain a stationary normalized 'vacuum' state, which satisfies two conditions analogous to the gauge conditions of electromagnetism (i.e., that the meson-field-difference, as well as its time derivative, give zero when applied to the vacuum state), to any desired degree of accuracy. The non-Hermitian part of the Hamiltonian contains the coupling of the meson-field-difference to an externally imposed c-number fluctuating white noise field, of the CSL (continuous spontaneous localization) form. This causes statevector reduction, as is shown in the extreme nonrelativistic limit. For example, a superposition of spatially separated wavepackets of a fermion will eventually be reduced to a single wavepacket: the meson-field-difference discriminates among the Yukawa-potential 'handles' attached to each wavepacket, thereby, selecting one wavepacket to survive by the CSL mechanism. Analysis beyond that given in this paper is required to see what happens when the fermions are allowed to move. It is possible that the 'vacuum' state becomes involved in the dynamics so that the 'gauge' conditions can no longer be maintained. DOE

N92-18411# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
HUYGENS PRINCIPLE AND THE MOVING CHARGE FIELD
I. A. Shelaev 1990 21 p In RUSSIAN; ENGLISH summary
(DE92-603678; JINR-R-2-90-30) Avail: NTIS HC/MF A03

The potential of a charged sphere moving uniformly and rectilinearly is calculated on the basis of the extended Huygens principle. It is shown that the potential is finite everywhere and at any velocity of the sphere motion and at the distance larger than the sphere radius its value approaches the one of a moving point charge. DOE

N92-18422# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
HUYGENS PRINCIPLE AND THE MOVING CHARGE FIELD
I. A. Shelaev 1990 20 p In RUSSIAN; ENGLISH summary
(DE92-603677; JINR-R-2-90-27) Avail: NTIS HC/MF A03

Extending the Huygens principle by including the concept of potential in it is shown to give an alternative description of the moving charge field in comparison with the retarded potential one. The equation for the potential of an arbitrary moving charge derived according to the principle is the wave equation with a nonzero right part. The description of the field of a point charge based on the extended Huygens principle demonstrates that at any velocity of a uniform and rectilinear motion the point charge potential is singular only at the space point which is occupied by the charge at the considered instant of time. DOE

N92-18423# Melbourne Univ., Parkville (Australia). School of Physics.
SPONTANEOUS CP VIOLATION FROM A QUATERNIONIC KALUZA-KLEIN THEORY
B. E. Hanlon and G. C. Joshi 1991 30 p
(DE92-603679; UM-P-90/85; OZ-90/25) Avail: NTIS HC/MF A03

Motivated by the isomorphism between the universal covering group of the six dimensional Lorentz group and the special linear group over the quaternions, a locally quaternionic covariant quantum mechanics is postulated to exist in six space-time dimensions. Compactifying onto the space-time M(exp 4) x S(exp 2) complex theory is retrieved on the four dimensional Minkowski space with the essential quaternionic nature confined to S(exp 2). Quaternionic spinors are introduced and a dimensionally reduced theory recovered which exhibits a CP violating effect via spontaneous symmetry breaking. DOE

N92-18467# International Centre for Theoretical Physics, Trieste (Italy).
ON A POSSIBLE ORIGIN OF MODULAR INVARIANCE
K. TahirShah Jun. 1991 15 p
(DE92-603592; IC-91/119) Avail: NTIS HC/MF A03

We propose an information theoretic model of the space-time pre-geometry where the pre-geometry is considered as a 'coded state of matter and space-time', distinctly different from the classical space-time or any known state of matter. Assuming that physical processes at Planck's dimensions are stochastic Markov processes and using information theoretic and algebro-geometric coding techniques, we show that modular invariance is a natural consequence of Shannon's channel capacity theorem. Nature selects and uses only those error-correcting codes to transfer information between space-time entities which allow the value of propagation rate R reaching its critical value R(sub C), the channel capacity. Next, using the strong converse theorem we show that a phase-transition occurs at (R(sub C)-R) less than epsilon, for some small epsilon greater than 0. Furthermore, it is known that some symmetrically packed optimal codes lead to an E(sub 8) lattice while others lead to a 26-dimensional Lorentz lattice used in string theories. This suggests a precise connection between our model and string theories. DOE

N92-18528# Los Alamos National Lab., NM.
MATRIX MODELS OF 2D GRAVITY
P. Ginsparg 1991 24 p Presented at the Trieste Summer School, Trieste (Italy), 22-25 Jul. 1991
(Contract W-7405-eng-36)
(DE92-004580; LA-UR-91-4101; CONF-9107195-1) Avail: NTIS HC/MF A03

These are introductory lectures for a general audience that give an overview of the subject of matrix models and their application to random surfaces, 2d gravity, and string theory. They are intentionally 1.5 years out of date. DOE

N92-18657# International Centre for Theoretical Physics, Trieste (Italy).
A GEOMETRIC DERIVATION OF THE STRONG COUPLING CONSTANT
E. Recami and V. ToninZanchin (Universidade Estadual de Campinas, Brazil) Aug. 1991 8 p
(DE92-604034; IC-91/213) Avail: NTIS HC/MF A02

Since more than a decade, a bi-scale, unified approach to strong and gravitational interactions has been proposed that uses the geometrical methods of general relativity, and yielded results similar to 'strong gravity' theories. We fix our attention on hadron structure, and show that also the strong interaction strength alpha(sub S), ordinarily called the '(perturbative) coupling-constant square', can be evaluated within our theory, and found to decrease (increase) as the 'distance' r decreases (increases). This yields both the confinement of the hadron constituents (for large values

of r) and their asymptotic freedom (for small values of r inside the hadron), in qualitative agreement with the experimental evidence. In other words, our approach leads us, on a purely theoretical ground, to a dependence of alpha(sub S) on r which had been previously found only on phenomenological and heuristic grounds. We expect the above agreement to be also quantitative, on the basis of a few checks performed in this paper, and of further work of ours about calculating meson mass-spectra.
DOE

N92-18817# Air Force Inst. of Tech., Wright-Patterson AFB, OH.
IMPROVEMENT OF THE THERMODYNAMIC MODEL FOR A FLUX-DIFFERENCE-SPLITTING ALGORITHM FOR THE COMPUTATION OF HIGH SPEED FLOWS M.S. Thesis
Mark E. Schieve Dec. 1991 109 p
(AD-A244285; AFIT/GAE/ENY/91D-10) Avail: NTIS HC/MF A06 CSCL 21/2

This study modifies the thermodynamic model of a previously existing first-order accurate Flux Difference Splitting (FDS) Algorithm for planar, supersonic nozzles. The thermodynamic model is changed from a calorically and thermally perfect gas to a thermally perfect (imperfect) gas, where the flow field is frozen or non-reacting. The frozen flow and imperfect gas assumptions more nearly approximate the real behavior of a fluid in supersonic propulsive nozzles. The modified code can now account for specific heats that vary as a function of temperature. Using curve fittings of JANAF thermochemical data, the code can handle nine gas species, as well, to model combustion products entering the nozzle inlet. The marching scheme is not altered in order to retain the robustness and efficiency of the first-order method. An oblique shock reflection study is done to validate the improved gas model. A low pressure, low temperature case and a high pressure, high temperature case are run. For the first case, the perfect and imperfect models are nearly identical. For the more extreme case, pressure for the perfect gas is 9.4 percent greater than the exact solution, at the upper boundary, across the shock. An interior flow nozzle is run for the two cases, with air as the working fluid. Again, the two models give identical results for the low pressure case. For the high pressure case, integrated nozzle thrust for the imperfect gas model is 16 percent higher than that for the original perfect gas model.
GRA

N92-18929# Technische Univ., Delft (Netherlands).
HEAT CAPACITY MEASUREMENTS ON SOME HIGH-TEMPERATURE SUPERCONDUCTORS BELOW 1 K BY MEANS OF TWO NON-ADIABATIC METHODS Ph.D. Thesis
Robert Wilhelm Willekers 1991 160 p
(ETN-92-90974) Avail: NTIS HC/MF A08

The experimental setup and block diagrams of the equipment used are described. Heat conductivity measurements on some materials and systems that were important for the testing of the apparatus and for the construction of the supporting equipment are described. The development and testing of new types of thermometers, used in the later calorimetry experiments, is discussed. These thermometers appeared to play a crucial role in obtaining the accuracy of the results of the heat capacity and heat conductivity measurements. Research on radiation damage of some types of thermometers is addressed. The method and peripheral equipment developed and used for the heat capacity measurements are described. The measurements, as performed with the setup on magnetic superconductors, particularly on the 90 K superconductors on the REBa2Cu3O(7-delta) series are presented. To obtain more information about the behavior of the samples when using the non-adiabatic methods for the heat capacity measurements, the heat conduction of some of these materials was measured. Some interesting phenomena associated with the magnetic phase transitions are discussed.
ESA

80 SOCIAL SCIENCES (GENERAL)

Includes educational matters.

No abstracts in this category.

81 ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

N92-18427# Carnegie-Mellon Univ., Pittsburgh, PA. Center for Energy and Environmental Studies.
DEVELOPMENT AND APPLICATION OF A PROBABILISTIC EVALUATION METHOD FOR ADVANCED PROCESS TECHNOLOGIES
H. C. Frey and E. S. Rubin Apr. 1991 364 p
(Contract DE-AC21-88MC-24248)
(DE91-002095; DOE/MC-24248/3015) Avail: NTIS HC/MF A16

The objective of this work is to develop and apply a method for research planning for advanced process technologies. To satisfy requirements for research planning, it is necessary to: (1) identify robust solutions to process design questions and, in the face of uncertainty, to eliminate inferior design options; (2) identify key problem areas in a technology that should be the focus of further research to reduce the risk of technology failure; (3) compare competing technologies on a consistent basis to determine the risks associated with adopting a new technology; and (4) evaluate the effects that additional research might have on comparisons with conventional technology. An important class of process technologies are electric power plants. In particular, advanced clean coal technologies are expected to play a key role in the energy and environmental future of the U.S., as well as in other countries. Research planning for advanced clean coal technology development is an important part of energy and environmental policy. Thus, the research planning method developed here is applied to case studies focusing on a specific clean coal technology. The purpose of the case studies is both to demonstrate the research planning method and to obtain technology-specific conclusions regarding research strategies.
DOE

N92-18874# Missouri Univ., Columbia.
AGGREGATION NETWORKS FOR UNCERTAINTY MANAGEMENT Final Report, 1 Nov. 1989 - 31 Oct. 1991
Raghu Krishnapuram and James Keller 25 Nov. 1991 20 p
(Grant AF-AFOSR-0038-90; AF Proj. 2304)
(AD-A244399; AFOSR-91-1020TR) Avail: NTIS HC/MF A03 CSCL 05/1

In this project, two methodologies for evidence aggregation and information fusion were studied. One methodology uses fuzzy-set-theoretic connectives in a hierarchical network to achieve the fusion. Learning methods for determining the nature and structure of the networks are investigated. The second methodology uses a generalization of the fuzzy integral to achieve the fusion. In addition, various techniques for membership function generation (including fuzzy clustering methods), fuzzy logic inference and morphological edge detection and fusion were investigated.
GRA

N92-18930# Logistics Management Inst., Bethesda, MD.
THE FEASIBILITY OF A SINGLE DISCREPANCY REPORTING SYSTEM Final Report
Donald F. Egan, Harry L. Featherstone, Richard J. Frome, and John J. Ott Sep. 1991 83 p
(Contract MDA903-90-C-0006)
(AD-A243801; LMI-DL902R2) Avail: NTIS HC/MF A05 CSCL 05/2

The Department of Defense acquires, manages, issues, and transports an immense amount of materiel each year. Discrepancy reporting is the process of identifying and resolving problems with

that materiel. Currently, discrepancy reports are processed in a predominately manual environment and are implemented under separate joint regulations. This report evaluates the feasibility of consolidating the discrepancy reporting into a standard set of procedures and integrating the automation of discrepancy reporting. The report makes recommendations on improving discrepancy reporting, whereby DoD can improve materiel availability. product quality, and service to operating units. Further, implementation of the recommendations can result in net direct cost savings of $12.8 million over 8 years. GRA

N92-18616*# National Aeronautics and Space Administration, Washington, DC.
LESSONS LEARNED AND THEIR APPLICATION TO PROGRAM DEVELOPMENT AND CULTURAL ISSUES
Gilbert L. Roth *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 57-60 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18619# Aerospatiale, Cannes (France).
CRITICALITY MANAGEMENT IN SPACE PROGRAMS
J. Charron, B. Marguerin, A. Benes, and D. Gonzalez *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 71-77 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18634# Messerschmitt-Boelkow-Blohm G.m.b.H., Munich (Germany, F.R.). Design Assurance Dept.
A MANAGERIAL APPROACH FOR RELIABILITY VERIFICATION OF MECHANICAL EQUIPMENT
Gerhard Albrecht *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 165-167 (For primary document see N92-18607 09-31)
(MBB-UK-0140-PUB; OTN-033148) Copyright Avail: NTIS HC/MF A13

N92-18640# Saab Space A.B., Goeteborg (Sweden). Product Assurance Dept.
IMPLEMENTATION OF THE TOTAL QUALITY MANAGEMENT CONCEPT WITHIN SPACE BUSINESS
Claes Berlin *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 195-202 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

N92-18643# Societe Europeenne de Propulsion, Saint-Medard-en-Jalles (France). Div. Propulsion a Poudre et Composites.
THE COMPUTERIZED MANAGEMENT OF TECHNICAL DATA: TECHNICAL MEMORY OF THE INDUSTRIAL ENTERPRISE
J. Nuyts and A. Costecalde *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 219-223 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

82 DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography.

For computer documentation see *61 Computer Programming and Software.*

N92-18039# Westinghouse Hanford Co., Richland, WA.
BEYOND THE MEDIA: A NEW STRATEGY FOR DISTRIBUTING SCIENTIFIC AND TECHNICAL INFORMATION
B. L. Preecs Nov. 1991 12 p Presented at the Making Information Work, Washington, DC, 21-23 Jan. 1992
(Contract DE-AC06-87RL-10930)
(DE92-003633; WHC-SA-1292; CONF-920145-1) Avail: NTIS HC/MF A03

Communications media -- newspapers, television, magazines, etc. -- may be the most powerful single influence on modern life. Certainly they are the most important source of information citizens use to form opinions about such complex scientific questions as global warming or nuclear waste cleanup. But commercial news media have built-in limitations on their effectiveness as information sources. Reliance on advertising for revenue means the media are limited in the volume of material they can cover. In addition, the need to attract the largest possible, or the most select, audience for advertisers limits the complexity of information that the media can present. Finally, existing media organizations offer few, if any, ways for users to retrieve past information. These limitations deprive citizens of needed information, increase pressure on political leaders, and create the gridlock over scientific and public policy questions caused by the 'Not in My Backyard' syndrome. Fortunately, modern communications technology is changing in ways that allow public policy makers to address these shortenings. Companies now barred from the information business are seeking to enter, existing media companies are looking for new sources of revenue, and new information products are seeking markets. Several changes to existing media and communications policy will be suggested and general principles for building a better overall communications system will be discussed. DOE

N92-18084# Oak Ridge K-25 Site, TN.
ENGINEERING DESIGN INFORMATION SYSTEM (EDIS) USER MANUAL
P. S. Smith and R. D. Short Nov. 1991 89 p
(Contract DE-AC05-84OT-21400)
(DE92-004110; K/CSD/TM-95/Rev-1) Avail: NTIS HC/MF A05

This manual is a guide to the use of the Engineering Design Information System (EDIS). The system runs on the Martin Marietta Energy Systems, Inc., IBM 3084 unclassified computer. EDIS is in the second phase of implementation, which provides an index, storage, and retrieval system for engineering documents produced at various plants and laboratories operated by Energy Systems for the Department of Energy (DOE). The second phase also provides additional hard copy request functionality. Section 2.0 of this manual presents an overview of EDIS, describing the system's purpose; the functions it performs; hardware, software, and security requirements; and help and error functions. Section 3.0 describes how to access EDIS and how to operate system functions using Database 2 (DB2), Time Sharing Option (TSO), Interactive System Productivity Facility (ISPF), Soft Master viewing, and FT/Express file transfer features employed by this system. Appendix A lists the special hardware and software requirements that must be met to run the View function. Appendix B contains a description of the Soft Master viewing capabilities provided through the EDIS View function. Appendix C contains a list of special hardware and software requirements for the store and download functions of EDIS. Appendix D provides examples of the system error screens and help screens for valid codes used for screen entry. Appendix E contains a dictionary of data elements and descriptions. DOE

N92-18093# Westinghouse Hanford Co., Richland, WA.
DEVELOPMENT OF AN ADMINISTRATIVE RECORD SYSTEM AND INFORMATION REPOSITORY SYSTEM TO SUPPORT ENVIRONMENTAL CLEANUP AT THE HANFORD SITE IN RICHLAND, WASHINGTON
B. S. Sprouse Sep. 1991 15 p Presented at the Environmental Remediation 1991 Conference, Pasco, WA, 8-11 Sep. 1991
(Contract DE-AC06-87RL-10930)
(DE92-002049; WHC-SA-1182; CONF-910981-32) Avail: NTIS HC/MF A03

The purpose of this paper is to describe the development of an administrative record (AR) file system for the Hanford Site in Richland, Washington. This paper will focus on the background of the AR system and its implementation at the Hanford Site; the types of documents to be included in an AR file; the management system used to develop and implement the AR system; the unique

characteristics of the AR system; and the role of the information repositories. The objective of this session is to present the methodology used in developing an AR and information repository system so that common hurdles from various sites can be addressed and resolved similarly. Therefore, unnecessary effort does not have to be put forth to resolve the same issues over and over again. The concepts described can be applied to all federal facility sites with a minimum amount of modification and revision. DOE

N92-18143# California Univ., Berkeley. Lawrence Berkeley Lab.
PROBLEMS UNDERLYING THE USE OF REFERENTIAL INTEGRITY MECHANISMS IN RELATIONAL DATABASE MANAGEMENT SYSTEMS
V. M. Markowitz Dec. 1990 9 p Presented at the 7th IEEE International Conference on Data Engineering, Kobe, Japan, 8-12 Apr. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004304; LBL-30104; CONF-9104321-1) Avail: NTIS HC/MF A02

Referential integrity is used in relational data-bases for expressing existence dependencies between tuples. Relational database management systems (RDBMS) provide diverse referential integrity capabilities. Thus, is some RDBMSs referential integrity constraints can be specified non-procedurally (declaratively), while in other RDBMSs they must be specified procedurally. Moreover, some RDBMSs restrict the class of allowed referential integrity constraints. We examine in this paper the main problems underlying the use of referential integrity mechanisms in three representative RDBMSs, DB2, SYBASE, and INGRES. DOE

N92-18177# Mound Lab., Miamisburg, OH.
COLLECTION, PRESENTATION, AND ANALYSIS OF INSPECTION DATA
C. A. Applegate, M. A. Tibbs, L. R. Ratliff, and W. C. Wyder Nov. 1991 50 p
(Contract DE-AC04-88DP-43495)
(DE92-003738; MLM-3711) Avail: NTIS HC/MF A03

The handling of large volumes of inspection data printouts was a problem in PM Building, where the inspection data were being generated from Computer Numerical Controlled Coordinate Measuring Machines (CMM). The inspection of a group of 600 pieceparts could generate a stack of printer paper five to six inches high. To collect only the useful data from the inspections, a change to the CMM software was purchased, which allows the transfer of only measurement data to a second computer. From the second computer, the data are saved in a tabular format on a floppy disk, using a piece of software created especially for this purpose. The floppy disk is then used to transfer the data to a computer workstation where it is made presentable and analyzed in a LOTUS spreadsheet. From the analysis, the inspected product can be accepted or rejected; the capability of the process can be determined; and finally, future inspection requirements can be evaluated and modified. This technique results in a compact document or electronic file containing all the important data in a presentable, usable, and easily understood format. DOE

N92-18243*# NASA Scientific and Technical Information Facility, Baltimore-Washington International Airport, MD.
ACQUISITION PLAN FOR DIGITAL DOCUMENT STORAGE (DDS) PROTOTYPE SYSTEM
Apr. 1990 82 p
(Contract NASw-4070)
(NASA-CR-189792; NAS 1.26:189792) Avail: NTIS HC/MF A05 CSCL 05B

NASA Headquarters maintains a continuing interest in and commitment to exploring the use of new technology to support productivity improvements in meeting service requirements tasked to the NASA Scientific and Technical Information (STI) Facility, and to support cost effective approaches to the development and delivery of enhanced levels of service provided by the STI Facility. The DDS project has been pursued with this interest and commitment in mind. It is believed that DDS will provide improved archival blowback quality and service for ad hoc requests for paper copies of documents archived and serviced centrally at the STI Facility. It will also develop an operating capability to scan, digitize, store, and reproduce paper copies of 5000 NASA technical reports archived annually at the STI Facility and serviced to the user community. Additionally, it will provide NASA Headquarters and field installations with on-demand, remote, electronic retrieval of digitized, bilevel, bit mapped report images along with branched, nonsequential retrieval of report subparts. Author

N92-18254*# NASA Scientific and Technical Information Facility, Baltimore-Washington International Airport, MD.
DIGITAL DOCUMENT IMAGING SYSTEMS: AN OVERVIEW AND GUIDE
1 Aug. 1990 89 p
(Contract NASw-4070)
(NASA-CR-189791; NAS 1.26:189791) Avail: NTIS HC/MF A05 CSCL 05B

This is an aid to NASA managers in planning the selection of a Digital Document Imaging System (DDIS) as a possible solution for document information processing and storage. Intended to serve as a manager's guide, this document contains basic information on digital imaging systems, technology, equipment standards, issues of interoperability and interconnectivity, and issues related to selecting appropriate imaging equipment based upon well defined needs. Author

N92-18255*# NASA Scientific and Technical Information Facility, Baltimore-Washington International Airport, MD.
FULL-SCALE SYSTEM IMPACT ANALYSIS: DIGITAL DOCUMENT STORAGE PROJECT Final Report
12 Mar. 1989 96 p
(Contract NASw-4070)
(NASA-CR-189793; NAS 1.26:189793) Avail: NTIS HC/MF A05 CSCL 05B

The Digital Document Storage Full Scale System can provide cost effective electronic document storage, retrieval, hard copy reproduction, and remote access for users of NASA Technical Reports. The desired functionality of the DDS system is highly dependent on the assumed requirements for remote access used in this Impact Analysis. It is highly recommended that NASA proceed with a phased, communications requirement analysis to ensure that adequate communications service can be supplied at a reasonable cost in order to validate recent working assumptions upon which the success of the DDS Full Scale System is dependent. Author

N92-18256*# NASA Scientific and Technical Information Facility, Baltimore-Washington International Airport, MD.
PILOT PRODUCTION SYSTEM COST/BENEFIT ANALYSIS: DIGITAL DOCUMENT STORAGE PROJECT Final Report
29 Dec. 1989 103 p
(Contract NASw-4070)
(NASA-CR-189795; NAS 1.26:189795) Avail: NTIS HC/MF A06 CSCL 05B

The Digital Document Storage (DDS)/Pilot Production System (PPS) will provide cost effective electronic document storage, retrieval, hard copy reproduction, and remote access for users of NASA Technical Reports. The DDS/PPS will result in major benefits, such as improved document reproduction quality within a shorter time frame than is currently possible. In addition, the DDS/PPS will provide an important strategic value through the construction of a digital document archive. It is highly recommended that NASA proceed with the DDS Prototype System and a rapid prototyping development methodology in order to validate recent working assumptions upon which the success of the DDS/PPS is dependent. Author

N92-18369# Polish Academy of Sciences, Warsaw. Instytut Podstawowych Problemow Techniki.
TWO-STEP ORDERING OF LEXICOGRAPHICAL ENTRIES IN VARIOUS LANGUAGES
Andrzej Ziabicki 7 Apr. 1990 57 p In POLISH; ENGLISH summary
(ISSN-0208-5658) Avail: NTIS HC/MF A04

Based on the theory of ordering alphanumeric strings, computer techniques for ordering lexicographical entries (words, abbreviations, sequences of characters) in various languages were developed. Two-step ordering is considered: primary, lexicographical order according to the appropriate alphabet, and secondary order based on diacritical marks (accents, diaeresis, vocation, etc.). For any language, ordering system is characterized by several logical variables describing existence of ligatures, diphtongs, triple characters representing two contracted diphtongs, diacritical marks, and modification of the standard roman alphabet. Detailed information is included in the variables ALPHABET and DIACRITS. A master program written in the FoxBase database language is described and two examples of application, Czech and German, are discussed. Author

N92-18405# Oak Ridge National Lab., TN.
NRC DATA BASE FOR POWER REACTOR SURVEILLANCE PROGRAMS AND FOR IRRADIATION EXPERIMENTS RESULTS
F. B. K. Kam and F. W. Stallmann 1991 6 p Presented at the Working Group 3 Joint Coordinating Committee on Nuclear Reactor Safety (JCCNRS) Meeting, Oak Ridge, TN, 16-18 Oct. 1991
(Contract DE-AC05-84OR-21400)
(DE92-001687; CONF-9110236-2) Avail: NTIS HC/MF A02

The radiation damage of pressure vessel materials in nuclear reactors depends on many different factors, primarily fluence, fluence spectrum, fluence rate, irradiation temperature, and chemistry. These factors and, possibly, others such as heat treatment and type of flux used in weldments must be considered to reliably predict the pressure vessel embrittlement and to assure the safe operation of the reactor. Based on embrittlement predictions, decisions must be made concerning operating parameters, low-leakage fuel management, possible life extension, and the need for annealing of the pressure vessel. Large numbers of data obtained from surveillance capsules and test reactor experiments are needed, comprising many different materials and different irradiation conditions, to develop generally applicable damage prediction models that can be used for industry standards and regulatory guides. The US Nuclear Regulatory Agency has, therefore, sponsored a project to construct an Embrittlement Data Base (EDB) for a comprehensive collection of data concerning changes in material properties of pressure vessel steels due to neutron irradiation. A first version containing data from surveillance capsules of commercial power reactors, the Power Reactor Embrittlement Data Base (PR-EDB) Version 1, has been completed and is available to authorized users from the Radiation Shielding Information Center at the Oak Ridge National Laboratory. This document provides a discussion of the features of the current database. DOE

N92-18418# Virginia Univ., Charlottesville. Dept. of Computer Science.
THE ADAMS INTERACTIVE DICTIONARY BROWSER Ph.D. Thesis
B. M. Segal 17 Dec. 1990 27 p
(Contract DE-FG05-88ER-25063)
(DE91-014347; DOE/ER-25063/T11) Avail: NTIS HC/MF A03

The ADAMS-IDB is concerned with the structure created by the user's DDL statements and provides a graphically interactive environment to facilitate searching the schema. This paper gives a brief overview of ADAMS and presents the terminology that is necessary for a user of the ADAMS-IDB. Section 3 discusses the ADAMS-IDB itself. First, a description of the tool is given followed by a discussion of why and how the tool was developed. Section 4 discusses how the browser is structured. Section 5 discusses some observations the developer had concerning the ADAMS project in general while building the graphical interface. Section 6 is a User Guide which examines the ADAMS-IDB's graphical interface from a user point of view and steps the user through invocation, browsing, and termination of the ADAMS-IDB. Finally, Section 7 describes the output displayed by the browser and walks through an example of its usage. DOE

N92-18659# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France). Technical Information Panel.
INTELLECTUAL PROPERTY RIGHTS
Oct. 1991 235 p In ENGLISH and FRENCH Lecture series held in London, England, 21-22 Oct. 1991, in Brussels, Belgium, 24-25 Oct. 1991, and in Arlington, VA, 6-7 Nov. 1991
(AGARD-LS-181; ISBN-92-835-0639-1) Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Intellectual property has become one of the keys to the management of high technology sectors and communication systems. The concept is, however, used to describe a variety of different situations influenced by the combined effect of technical and economic change. From this results an intensive legal activity, not only in the passing of new legislation and the creation of jurisprudence, but also in the field of contractual and professional practice, which is becoming more important. The aim of this Lecture Series is therefore to provide a few markers, to look at the prospects for these trends and to assess the stakes involved, so as to enable better evaluation and control of national and international legal practices. For individual titles, see N92-18660 through N92-18667.

N92-18660# Montpellier Univ. (France). Faculty of Law and Economic Science.
INTELLECTUAL PROPERTY AND INFORMATION: A COMPARATIVE INTERNATIONAL OVERVIEW
Michel Vivant *In* AGARD, Intellectual Property Rights Oct. 1991 10 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The methods that different national legal systems use to respond to the challenges of new information and communications technologies is examined. Additionally, the common features of what is at stake and the steps taken to cope with these identical challenges are highlighted. At the same time, the divergencies in philosophies and practices, which are sources of division between one country and another and thus run counter to the establishment of a sound and steady information products and services market, are pointed out. Author

N92-18661# Defence Research Agency, London (England). Intellectual Property Dept.
SECTOR BASED LOGIC AND PRACTICE OF INTERNATIONAL COMPANIES IN THE FIELDS OF DATA MANAGEMENT AND TECHNOLOGY TRANSFER
Robert W. Beckham *In* AGARD, Intellectual Property Rights Oct. 1991 5 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

In considering data management and technology transfer, it is found that different areas of industry and other organizations operating in technological fields have developed policies which best reflect the environment, both legal and national, in which they operate. Furthermore, attitudes of individual companies are colored by the attitudes of immediate competitors. In this talk, consideration will be given to the effectiveness of legal protection mechanisms in various parts of the world. It should be particularly noted that legal mechanisms specifically intended to promote technology transfers, particularly systems of compulsory licensing, often have the opposite effects, restricting both the availability of information and technology transfer. Author

N92-18662# Copyright Licensing Agency, London (England).
REPRODUCTION: LEGAL LICENCE AND CONTRACTUAL PROCEDURES. PRINCIPLES AND PRACTICE
Colin P. Hadley *In* AGARD, Intellectual Property Rights Oct. 1991 18 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Emphasis is on the practice and principles of licensing facsimile reproduction of copyright material. The principles of collective licensing, and the practice and the day-to-day running of a collecting society are examined. Electrocopying and the technologies being developed at the Copyright Licensing Agency to deal with this and other new advances in communication are also examined. Author

N92-18663# Database Development, Shorewood, WI.
ELECTRONIC INFORMATION SERVICES: PARTICULARITIES AND SELF-REGULATION (CONTRACTS AND CODES OF CONDUCT)
Joe Bremner *In* AGARD, Intellectual Property Rights Oct. 1991 30 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Traditionally, users of electronic information services have signed 'subscription agreements', which specify, not just what will be delivered, and the price, but state specific conditions on the use of the information. The basic intent of these agreements is to effect a license of the work - not a sale. While it may appear that the practices of database publishers and online hosts are awkward or unusual, they are based on sound business judgements. Publishers and hosts have had to contend with an international distribution environment that outstripped the state of international intellectual property laws; hence, they relied on contract law. The topics covered include: (1) industry background; (2) industry practices; (3) intellectual property issues; and (4) database distribution policies in the future. Author

N92-18664# Gesellschaft fuer Mathematik und Datenverarbeitung, Cologne (Germany, F.R.).
PUBLIC SECTOR INFORMATION: TOWARDS A COMPREHENSIVE INFORMATION POLICY FOR RECONCILING DIVERGING INTERESTS
Herbert Burkert *In* AGARD, Intellectual Property Rights Oct. 1991 10 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

There is an increasing need for public sector information expressed by individuals, organizations, and other public sector institutions, and within the framework of international cooperation. With the move towards electronic filing, public sector information resources are being rediscovered by the private sector intending to service these needs. Against the background of budgetary restraints, the public sector develops its own market interests in its information resources. These diverging interests call for comprehensive information policies. In trying to develop such policies, the public sector sees itself faced with a regulatory environment comprising copyright, secrecy regulations, privacy and access to government information regulations, as well as competition law. The interests are analyzed behind these regulations, their impact on the availability of public sector information and the problems they create with the change in public sector information handling from the traditional paper to the electronic filing environment. A balanced approach is pleaded for, which takes into account the specific functions of public sector information. Author

N92-18665# Controle General des Armees, Paris (France).
TRANSFERS OF TECHNOLOGY: INTERNATIONAL NEGOTIATIONS AND WORK IN PROGRESS
Paul Freiermuth *In* AGARD, Intellectual Property Rights Oct. 1991 8 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

Areas of discussion which were presented at the COCOM meeting held in Paris on 23 and 24 May, 1991 are examined. The conferences were cognizant of the problems inherent in technology transfer. The meeting highlighted the government's problem of how to define a simple set of lines of conduct relating to technology for government (military) use. The three main topical areas of discussion are as follow: the end use of transfers of technology are many and varied, often falling into a political context of industrial strategy and appropriate legal instruments are used to implement them; how transfers of technology can take a variety of forms such as sale and as cooperation agreements; and how the obstacles have cultural, economic, technical, or political connotations. E.R.

N92-18666# Commission of the European Communities, Brussels (Belgium).
THE NEW EUROPE
Bridget Czarnota *In* AGARD, Intellectual Property Rights Oct. 1991 9 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

The characteristics and development of the information market in Europe are discussed. Topics covered include the actions taken by the European Community towards a European information market and the regulatory framework, including questions of patents, trademarks, and copyrights. Issues of standardization and the use of proprietary intellectual property rights are discussed, as well as research and development contracts. Relations among countries and the role of the European Community in the international forum are discussed. Author

N92-18667# Information Industry Association, Washington, DC.
INFORMATION AND RESPONSIBILITY
Steven J. Metalitz *In* AGARD, Intellectual Property Rights Oct. 1991 17 p (For primary document see N92-18659 09-82)
Copyright Avail: NTIS HC/MF A11; Non-NATO Nationals requests available only from AGARD/Scientific Publications Executive

A complex network of legal rights and responsibilities is part of the environment within which information products and services are developed and distributed. A brief survey of some aspects of this network or web of responsibility is provided from the perspective of the information content provider. Responsibilities to authors and other sources are governed by copyright principles, especially those recently discussed by the U.S. Supreme Court in the Feist case. Debate over responsibilities to data subjects has recently been dominated by discussion of the draft European Commission directive on data protection. Responsibilities to data consumers and customers are generally governed by expressed or implied contract terms, while responsibilities to end-users and ultimate beneficiaries of information products and services implicates questions of negligence and strict liability. Observations on the role of business and government in clarifying and defining legal responsibilities for information are given. Author

N92-18814# Federal Aviation Administration, Cambridge, MA. Research and Special Programs Administration.
BIBLIOGRAPHY OF TECHNICAL REPORTS, 1980 - 1990
Marilyn Gross (Dynatrend, Inc., Woburn, MA.) Apr. 1991 384 p (PB92-110691; DOT-VNTSC-RSPA-91-1) Avail: NTIS HC/MF A17 CSCL 05B

The bibliography lists reports released by the Volpe National Transportation Systems Center from Jan. 1980 to Dec. 1990. Reports are listed by sponsoring agency and are indexed by author, title, subject, report number, and performing organization. GRA

N92-18881# California Univ., Berkeley.
DATA BASE SUPPORT FOR COMPLEX OBJECTS AND EXPERT SYSTEMS Final Report, 15 Jul. 1987 - 14 Jun. 1990
Michael Stonebraker and Lawrence Rowe 31 Jul. 1991 4 p (Contract DAAL03-87-K-0083)
(AD-A244407; ARO-24537.5-EL) Avail: NTIS HC/MF A01 CSCL 05/1

During this research project, we have investigated facets of

the next generation DBMS, POSTGRES. Specifically, we have worked on four of its aspects, namely: (1) the data model and query language; (2) the rule system; (3) a novel no-overwrite storage manager; and (4) execution parallelism. We briefly report on our accomplishments in each of these areas. GRA

N92-18884# National Archives and Records Service, Washington, DC.
FEDERAL RECORDS MANAGEMENT: LAWS AND REGULATIONS
1 Jan. 1991 75 p
(PB92-100700) Avail: NTIS HC/MF A04 CSCL 05B

The purpose is to provide Federal Records Managers with a convenient reference source for laws and regulations relating to records management. All records management-related portions of the U.S. Code (USC), which is the codification of all current U.S. Federal statutes, are included. All National Archives and Records Administration (NARA) records management regulations in the Code of Federal Regulations (CFR), which is the codification of all current U.S. Federal regulations, are also presented. GRA

N92-18644# Societe Europeenne de Propulsion, Vernon (France).
PAST-EXPERIENCE DATA BANKS
J. C. Derbes and G. Sciez *In* ESA, Space Product Assurance for Europe in the 1990s: An ESA Symposium Aug. 1991 p 225-227 (For primary document see N92-18607 09-31)
Copyright Avail: NTIS HC/MF A13

83 ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

No abstracts in this category.

84 LAW, POLITICAL SCIENCE AND SPACE POLICY

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

N92-18308# Committee on Appropriations (U.S. House).
DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS BILL, 1992
Bob Traxler Washington GPO 3 Jun. 1991 101 p Report together with supplemental views to accompany H.R. 2519 submitted by the Committee on Appropriations, 102d Congress, 1st Session, 3 Jun. 1991
(H-Rept-102-94; GPO-43-643) Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

The House of Representatives Committee on Appropriations report in explanation of a bill making appropriations for the Departments of Veterans Affairs, Housing and Urban Development, the National Aeronautics and Space Administration (NASA), and for sundry independent agencies, commissions, corporations, and offices for the fiscal year ending September 30,1992 is presented. For individual title, see N92-18309.

N92-18309# Committee on Appropriations (U.S. House).
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
In its Departments of Veterans Affairs and Housing and Urban Development, and Independent Agencies Appropriations Bill, 1992 3 Jun. 1991 p 63-67 (For primary document see N92-18308 09-84)
Avail: Document Room, House of Representatives, Washington, DC 20515 HC free

The House of Representatives Committee on Appropriations recommended a total appropriation for the National Aeronautics and Space Administration (NASA) of 13,651,117,000 dollars in fiscal year 1992, which represents a reduction of 2,070,148,000 dollars below 1991. Funding was suspended for the space station program. Details are given for appropriations in research and development; space flight, control, and data communications; construction of facilities; research and program management; and the Office of Inspector General. Author

85 URBAN TECHNOLOGY AND TRANSPORTATION

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation.

For related information see also *03 Air Transportation and Safety, 16 Space Transportation,* and *44 Energy Production and Conversion.*

N92-18507# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
TECHNOLOGY TRANSFER FROM THE SPACE EXPLORATION INITIATIVE
D. Buden 14 Jun. 1991 7 p Presented at the 9th Symposium on Space Nuclear Power Systems, Albuquerque, NM, 13-16 Jan. 1992
(Contract DE-AC07-76ID-01570)
(DE92-003317; EGG-M-91482; CONF-920104-21) Avail: NTIS HC/MF A02

Space exploration has demonstrated that it stimulates the national economy by creating new and improved products, increased employment, and provides a stimulus to education. The exploration of the Moon and Mars under the Space Exploration Initiative has the potential of accelerating this stimulation to the economy. It is difficult to identify all of the concrete ways this will be accomplished. However, many areas can be identified. The space exploration building blocks of power, propulsion, spacecraft, robotics, rovers, mining and manufacturing, communications, navigation, habitats, life support, and infrastructures are reviewed to identify possible technology areas. For example, better means for working in hazardous areas and handling hazardous waste are potential outcomes of this initiative. Methods to produce higher quality goods and to improve America's competitiveness in manufacturing will undoubtedly evolve from the need to produce products that must last many years in the harsh environments of space and planetary surfaces. Some ideas for technology transfer are covered in this paper. DOE

88 SPACE SCIENCES (GENERAL)

N92-18913# Swedish Inst. of Space Physics, Kiruna.
[ACTIVITIES REPORT OF THE SWEDISH INSTITUTE OF SPACE PHYSICS] Annual Report, 1990
Lars Eliasson, ed. 1991 64 p
(ISSN-0284-169X; ETN-92-90662) Avail: NTIS HC/MF A04

The research activities and organizational structure of the Swedish Institute of Space Physics are outlined. Development of the Viking Satellite Project in terms of the auroral energization processes, transient boundary layer processes, and substorm studies are described. Development of future satellites such as Freja, Promics-3, Cammice, and Aspera-C is discussed. Research based on ground based instrumentation, such as the study of sporadic E layers by strong magnetospheric electric fields, is described. Auroral research using optical methods is described. Other research projects undertaken by the institute over the course of 1990 are described. ESA

89 ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

N92-18021*# Space Telescope Science Inst., Baltimore, MD.
HUBBLE SPACE TELESCOPE: CYCLE 1 CALIBRATION PLAN. VERSION 1.0
Peggy Stanley, ed. and Chris Blades, ed. May 1990 153 p Revised
(Contract NAS5-26555)
(NASA-CR-189747; NAS 1.26:189747) Avail: NTIS HC/MF A08 CSCL 03A

The framework for quantitative scientific analysis with the Hubble Space Telescope (HST) will be established from a detailed calibration program, and a major responsibility of staff in the Telescope & Instruments Branch (TIB) is the development and maintenance of this calibration for the instruments and the telescope. The first in-orbit calibration will be performed by the SI Investigation Definition Teams (IDTs) during the Science Verification (SV) period in Cycle 0 (expected to start 3 months after launch and last for 5 months). Subsequently, instrument scientists in the TIB become responsible for all aspects of the calibration program. Because of the long lead times involved, TIB scientists have already formulated a calibration plan for the next observing period, Cycle 1 (expected to last a year after the end of SV), which has been reviewed and approved by the STScI Director. The purpose here is to describe the contents of this plan. Our primary aim has been to maintain through Cycle 1 the level of calibration that is anticipated by the end of SV. Anticipated accuracies are given here in tabular form - of course, these accuracies can only be best guesses because we do not know how each instrument will actually perform on-orbit. The calibration accuracies are expected to satisfy the normal needs of both the General Observers (GOs) and the Guaranteed Time Observers (GTOs). Author

N92-18022*# Space Telescope Science Inst., Baltimore, MD.
HUBBLE SPACE TELESCOPE: FAINT OBJECT SPECTROGRAPH INSTRUMENT HANDBOOK. VERSION 1.1
Holland C. Ford, ed. May 1990 124 p Revised
(Contract NAS5-26555)
(NASA-CR-189748; NAS 1.26:189748) Avail: NTIS HC/MF A06 CSCL 03A

The Faint Object Spectrograph (FOS) has undergone substantial rework since the 1985 FOS Instrument Handbook was published, and we are now more knowledgeable regarding the spacecraft and instrument operations requirements and constraints. The formal system for observation specification has also evolved considerably, as the GTO programs were defined in detail. This supplement to the FOS Instrument Handbook addresses the important aspects of these changes, to facilitate proper selection and specification of FOS observing programs. Since the Handbook was published, the FOS red detector has been replaced twice, first with the best available spare in 1985 (which proved to have a poor, and steadily degrading red response), and later with a newly developed Digicon, which exhibits a high, stable efficiency and a dark-count rate less than half that of its predecessors. Also, the FOS optical train was realigned in 1987-88 to eliminate considerable beam-vignetting losses, and the collimators were both removed and recoated for greater reflectivity. Following the optics and detector rework, the FOS was carefully recalibrated (although only ambient measurements were possible, so the far-UV characteristics could not be re-evaluated directly). The resulting efficiency curves, including improved estimates of the telescope throughput, are shown. A number of changes in the observing-mode specifications and addition of several optional parameters resulted as the Proposal Instructions were honed during the last year. Target-brightness limitations, which have only recently been formulated carefully, are described. Although these restrictions are very conservative, it is imperative that the detector safety be guarded closely, especially during the initial stages of flight operations. Restrictions on the use of the internal calibration lamps and aperture-illumination sources (TA LEDs), also resulting from detector safety considerations, are outlined. Finally, many changes have been made to the instructions for target acquisition specification. Author

N92-18068*# Southwest Research Inst., San Antonio, TX. Instrumentation and Space Research Div.
AERONOMICAL MODELING OF THE OUTER PLANETS
Semiannual Report
J. Hunter Waite, Jr. 1 Feb. 1992 27 p
(Grant NAGw-1684; SwRI Proj. 15-2762)
(NASA-CR-189847; NAS 1.26:189847) Avail: NTIS HC/MF A03 CSCL 03A

The purpose is twofold: to report the programmatic issues of the project as to accomplishments and anticipated work statement for the next six months and to report the technical findings of the project. From the programmatic point of view the study was a clear success. Four talks were given on the work: (1) a talk on electron Bremsstrahlung X ray production at the annual American Astronomical Society, Division of Planetary Studies meeting in October of 1990 in Charlottesville, Virginia; (2) a poster on proton precipitation at the May, 1991 American Geophysical Union in Baltimore, Maryland; (3) an invited paper on multispectral time dependent modeling at the International Union of Geodosy and Geomagnetism in Vienna in August of 1991; and (4) a paper at the annual Division of Planetary Studies of the American Astronomical Society held in Palo Alto in November of 1991 entitled 'Jovian Bremsstrahlung X Rays: A Ulysses Prediction' which predicted the Jovian auroral X ray flux that should be measured by the Ulysses Gamma Ray Burst experiment during the Ulysses spacecraft's closest encounter with Jupiter in February 1992. The Ulysses' prediction paper generated much interest from people studying the Jovian aurora and from experimenters on the Ulysses spacecraft. As a result of this interest two things happened: (1) a paper of the same title was submitted and accepted for publication in the January issue of the Geophysical Research Letters; and (2) a massive observing campaign was organized to provide supporting ultraviolet and infrared observations at the time of the Ulysses encounter. This observational interest allowed personnel at the Southwest Research Institute (SwRI) (Alan Stern, PI; Hunter Waite Co-I) to obtain director's discretionary time on the Hubble Space Telescope to support the Ulysses encounter by obtaining ultraviolet observations. Once the multiple wavelength observations are obtained in February, the auroral model developed under this project will be used to analyze the data with hopes of providing new insight into the physical processes responsible for the Jovian aurora. Author

N92-18183*# Space Telescope Science Inst., Baltimore, MD.
HUBBLE SPACE TELESCOPE: GODDARD HIGH RESOLUTION SPECTROGRAPH INSTRUMENT HANDBOOK. VERSION 2.1
Douglas K. Duncan and Dennis Ebbets (Ball Aerospace Systems Div., Boulder, CO.) May 1990 103 p Revised
(Contract NAS5-26555)
(NASA-CR-189749; NAS 1.26:189749) Avail: NTIS HC/MF A06 CSCL 03A

The Goddard High Resolution Spectrograph (GHRS) is an ultraviolet spectrometer which has been designed to exploit the imaging and pointing capabilities of the Hubble Space Telescope. It will obtain observations of astronomical sources with greater spectral, spatial and temporal resolution than has been possible with previous space-based instruments. Data from the GHRS will be applicable to many types of scientific investigations, including studies of the interstellar medium, stellar winds, chromospheres and coronae, the byproducts and endproducts of stellar evolution, planetary atmospheres, comets, and many kinds of extragalactic sources. This handbook is intended to introduce the GHRS to potential users. The main purpose is to provide enough information to explore the feasibility of possible research projects and to plan, propose and execute a set of observations. An overview of the instrument performance, which should allow one to evaluate the suitability of the GHRS to specific projects, and a somewhat more detailed description of the GHRS hardware are given. How observing programs will be carried out, the various operating modes

of the instrument, and the specific information about the performance of the instrument needed to plan an observation are discussed. Author

N92-18211# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
APPLICATION OF THE MAXIMUM ENTROPY METHOD FOR THE IMAGE RECONSTRUCTION OF COMPTON TELESCOPE DATA FROM THE REGION OF THE GALACTIC CENTER Thesis - Technische Univ. [ANWENDUNG DER MAXIMUM-ENTROPIE METHODE ZUR BILDREKONSTRUKTION VON COMPTON-TELESKOP-DATEN AUS DER REGION DES GALAKTISCHEN ZENTRUMS]
Martin Varendorff Jun. 1991 115 p In GERMAN
(MPE-229; ISSN-0178-0719; ETN-92-90629) Copyright Avail: NTIS HC/MF A06

The results of an observation of the galactic center in the MeV gamma ray domain are discussed in relation to measurements of other experiments. The results were obtained from the reduction of old balloon flight measurement data using the maximum entropy method, that was proved to be superior to other development methods for the calculation of celestial charts from Compton telescope data. It is shown that, with the assumption of a non-point source of the line radiation of the radioactive Al-26, the flight measurement data obtained with very different instruments agree within the errors of the measurements. The measured distribution of Al-26 agrees with that of CO in the galactic plane, with the measured distribution in Novae (N2 model), and with the thin hot plasma model (soft X domain). ESA

N92-18238*# SETS Technology, Inc., Mililani, HI.
A SPECTROSCOPIC INVESTIGATION OF THE ECLIPSING BINARY EPSILON AURIGAE Final Report, Jan. 1990 - Apr. 1991
Suchitra Balachandran 28 May 1991 10 p
(Contract NAS5-30760)
(NASA-CR-189256; NAS 1.26:189256) Avail: NTIS HC/MF A02 CSCL 03A

The objectives were to examine, in detail, the spectra of the eclipsing binary Epsilon Aurigae taken with the IUE satellite telescope during the 1982 to 1984 eclipse. All of the low resolution spectra were analyzed and UV light curves are presented. The primary findings are as follows: (1) a constant eclipse depth from 1600 A to longer wavelengths and a sharp drop in the eclipse depth from 1600 to 1200 A; (2) the absence of large amplitude fluctuations in the UV as expected from a Cepheid primary; and (3) equal ingress and egress times in contradiction to that interpreted from visible light curves. The effects of these findings on the eclipse geometry are being studied. Author

N92-18336# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Extraterrestrische Physik.
SUBMILLIMETER SPECTROSCOPY OF THE INTERSTELLAR MEDIUM IN STAR FORMING REGIONS Ph.D. Thesis - Ludwig-Maximilians-Univ.
Urs Ulrich Graf Jul. 1991 148 p
(MPE-228; ISSN-0178-0719; ETN-92-90628) Copyright Avail: NTIS HC/MF A07

The physical properties of molecular clouds associated with star formation are studied. Observations of the submillimeter and far infrared rotational lines of carbon monoxide reveals the existence of warm molecular gas in regions of massive star formation. Theoretical models of molecular clouds in the vicinity of H2 regions (photodissociation region models) indicate that they can produce this warm gas by UV heating. These models of energy balance on molecular clouds near star formation sites are tested by means of observations of an isotopic short millimeter line. The isotopic line is optically thin in most sources, making it possible to determine the column density in the warm gas component directly. ESA

N92-18569# Lawrence Livermore National Lab., CA.
HIGH RESOLUTION TELESCOPE Patent Application
N. A. Massie, inventor (to DOE) and Y. Oster, inventor (to DOE) 16 May 1990 39 p
(Contract W-7405-eng-48)
(DE92-004617; US-Patent-Appl-SN-524118; Patents-US-A7524118) Avail: NTIS HC/MF A03

A large effective-aperture, low-cost optical telescope with diffraction-limited resolution enables ground-based observation of near-earth space objects. The telescope has a non-redundant, thinned-aperture array in a center-mount, single-structure space frame. It employs speckle interferometric imaging to achieve diffraction-limited resolution. The signal-to-noise ratio problem is mitigated by moving the wavelength of operation to the near-IR, and the image is sensed by a Silicon CCD. The steerable, single-structure array presents a constant pupil. The center-mount, radar-like mount enables low-earth orbit space objects to be tracked as well as increases stiffness of the space frame. In the preferred embodiment, the array has elemental telescopes with subaperture of 2.1 m in a circle-of-nine configuration. The telescope array has an effective aperture of 12 m which provides a diffraction-limited resolution of 0.02 arc seconds. Pathlength matching of the telescope array is maintained by an electro-optical system employing laser metrology. Speckle imaging relaxes pathlength matching tolerance by one order of magnitude as compared to phased arrays. Many features of the telescope contribute to substantial reduction in costs. These include eliminating the conventional protective dome and reducing on-site construction activities. The cost of the telescope scales with the first power of the aperture rather than its third power as in conventional telescopes. DOE

N92-18722# Lawrence Livermore National Lab., CA.
SPECKLE IMAGING OF SATELLITES AT THE AIR FORCE MAUI OPTICAL STATION
T. W. Lawrence, D. M. Goodman, E. M. Johansson, and J. P. Fitch Oct. 1991 12 p Presented at the European Southern Observatory (ESO) Conference on High Resolution Imaging By Interferometry II, Garching, Fed. Republic of Germany, 14-18 Oct. 1991
(Contract W-7405-eng-48)
(DE92-004668; UCRL-JC-108740; CONF-9110296-1) Avail: NTIS HC/MF A03

We performed a series of experiments using the Air Force Maui Optical Station's 1.6 m telescope and a bare CCD detector to capture speckle images of various satellites. The speckle images were processed with bispectral techniques for recovering image Fourier phase as well as projection onto convex sets for recovering image Fourier magnitude from the projected autocorrelation. Results of imaging point stars and binaries are shown as a baseline assessment of our techniques. We have reconstructed high quality images of numerous satellites and will show reconstructions of a very familiar satellite: the Hubble Space Telescope. To our knowledge, this is the first demonstration of the use of bare CCD's for speckle imaging of relatively bright objects such as artificial satellites. DOE

90 ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

For related information see also *75 Plasma Physics.*

N92-18131# International Centre for Theoretical Physics, Trieste (Italy).
MULTIPLE SOLUTIONS FOR INHOMOGENEOUS ELLIPTIC PROBLEMS ARISING IN ASTROPHYSICS
M. Calahorrano and F. Dobarro Jul. 1991 19 p
(DE92-609040; IC-91/159) Avail: NTIS HC/MF A03

By variational and topological methods we prove the existence of a positive interval Lambda such that for all lambda epsilon Lambda there exists at least three positive solutions of (1.1) on Omega = D sub R ((x,y) epsilon R exp 2 sub + : x exp 2 + y sup 2 less than R sup 2), where f : R yields R is a function of

type (t sup sigma -t sup sigma + alpha) sub chi (0,1) (t) with sigma greater than 1 and alpha less than or = 1, h is a non negative bounded smooth function. Under some restrictions for f and h we show that Lambda is independent of R, for R big enough. This type of problem arises in an astrophysical gravity free model of solar flares given by Heyvaerts et al. DOE

N92-18162# International Centre for Theoretical Physics, Trieste (Italy).
CLASSICAL AND QUANTUM EVOLUTION OF COSMOLOGICAL PERTURBATIONS IN DIFFERENT SPACETIME BACKGROUNDS
Y. Anini Jun. 1991 12 p
(DE92-609093; IC-91/139) Avail: NTIS HC/MF A03

In this paper I discuss the evolution of cosmological perturbations on different cosmological backgrounds. Conformal transformations will be used to transform the equations of motion for perturbations which have time dependent coefficients into the equation of motion of a simple harmonic oscillator with constant frequency. In this way we may work out an exact solution for the equations of motion of the perturbations. By using the regularity boundary condition we pick up one particular solution for each mode. And from these regular solutions we evaluate the quantum state for each perturbation mode. DOE

N92-18268# National Geophysical Data Center, Boulder, CO.
SOLAR-GEOPHYSICAL DATA NUMBER 562, JUNE 1991. PART 1: (PROMPT REPORTS). DATA FOR MAY, APRIL 1991, AND LATE DATA
Helen E. Coffey Jun. 1991 154 p
(PB91-230201; SGD-562-Pt-1) Avail: NTIS HC/MF A08 CSCL 03B

A detailed index for 1990-1991 is given. Data for May 1991 include the solar terrestrial environment, International Ursigram and World Days Service (IUWDS) alert periods, solar activity indices, solar flares, solar radio emission and Stanford mean magnetic field. Data for April 1991 include solar active regions, sudden ionospheric disturbances, solar radio spectral observations, cosmic ray measurements by neutron monitor, and geomagnetic indices. Late data is given for solar radio emission in March-April 1991; geomagnetic indices for February-March 1991; and solar active regions errata for March 1991. Author

N92-18334# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Inst. fuer Astrophysik.
THE EARLY LIGHT CURVE OF THE SUPERNOVA 1987A Ph.D. Thesis - Technische Univ. [DIE FRUEHE LICHTKURVE DER SUPERNOVA 1987A]
Gerhard Mair 1991 169 p In GERMAN
(ETN-92-90626) Avail: NTIS HC/MF A08

For the investigation of the early light curve of Supernova 1987A, the hydrodynamic evolution of a supernova explosion was numerically simulated, and the theoretical light curve during the first day was calculated and compared with data from observation. The equations of the radiation hydrodynamics (for adaptive grids) were implicitly solved and the Eddington factor was calculated from the solution of the time independent radiative transfer equation. The results provide information concerning the explosion energy, the evolution of the explosion, and the significance of convective instabilities and of the effect of the stellar model on the light curve. ESA

N92-18400# International Centre for Theoretical Physics, Trieste (Italy).
ABOUT SOME REGGE-LIKE RELATIONS FOR (STABLE) BLACK HOLES
E. Recami and Vilson Tonin-Zanchin Aug. 1991 13 p
(DE92-603649; IC-91/212) Avail: NTIS HC/MF A03

Within a purely classical formulation of 'strong gravity', we associated hadron constituents (and even hadrons themselves) with suitable stationary, axisymmetric solutions of certain new Einstein-type equations supposed to describe the strong field inside hadrons. Such equations are nothing but Einstein equations - with cosmological term - suitably scaled down. As a consequence, the cosmological constant (lambda) and the masses M result in our theory to be scaled up and transformed into a 'hadronic constant' and into 'strong masses', respectively. Due to the unusual range of lambda and M values considered, we met a series of solutions of the Kerr-Newman-de Sitter (KNdS) type with such interesting properties that it is worth studying them - from our particular point of view - also in the case of ordinary gravity. This is the aim of the present work. The requirement that those solutions be stable, i.e., that their temperature (or surface gravity) be vanishingly small, implies the coincidence of at least two of their (in general, three) horizons. Imposing the stability condition of a certain horizon does yield (once chosen the values of J, q, and lambda) mass and radius of the associated black-hole. In the case of ordinary Einstein equations and for stable black-holes of the KNdS type, we get in particular Regge-like relations among mass M, angular momentum J, charge q, and cosmological constant (lambda). For instance, with the standard definitions Q(exp 2) is identical to Gq(exp 2) /(4(pi)(epsilon)(sub 0)c(exp 4)); a is identical to J/(Mc); m is identical to GM/c(exp 2), in the case lambda = 0 in which m(exp 2) = a(exp 2) + Q(exp 2) and if q is negligible we find m(exp 2) = J. When considering, for simplicity, lambda greater than 0 and J = 0 (and q still negligible), then we obtain m(exp 2) = 1/(9(lambda)). DOE

N92-18695# International Centre for Theoretical Physics, Trieste (Italy).
SOME DISCUSSION ON THE ACCELERATION MECHANISM OF PARTICLES IN THE TYPE-I PLASMA COMET
Zhongyuan Li and Sheyu Guo Jul. 1991 9 p
(DE92-603934; IC-91/150) Avail: NTIS HC/MF A02

Earlier, the large acceleration of plasma (300 cm/sq s) were already observed in type-I tail. Recently, the direct measurements for comet G-Z showed that the energy of particle reaches 2x10(exp 5) eV, an energy much higher than the initial energy of comet particles (less than or = 2x10(exp 4) eV). So there should be an accelerated process in the comet. DOE

N92-18720# California Univ., Berkeley. Lawrence Berkeley Lab.
SUPERSPACE WZW MODELS AND BLACK HOLES
M. Rocek, C. Ahn, K. Schoutens (State Univ. of New York, Stony Brook.), and A. Sevrin Oct. 1991 12 p Presented at the Workshop on Superstrings and Related Topics, Trieste, Italy, Aug. 1991
(Contract DE-AC03-76SF-00098)
(DE92-004169; LBL-31325; IASSNS-HEP-91/69; ITP-SB-91-49; UCB-PTH-91/50; CONF-9108185-1) Avail: NTIS HC/MF A03

We show how to write an off-shell action for the SU(2) x U(1) supersymmetric WZW model in terms of N = 2 chiral and twisted chiral multiplets. We discuss the N = 4 supersymmetry of this model and exhibit the N = 4 superconformal current algebra. Finally, we show that the off-shell formulation makes it possible to perform a duality transformation, which leads to a supersymmetric sigma model on a manifold with a black hole type singularity. DOE

91 LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights.

For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance.*

N92-18174# Edgerton, Germeshausen and Grier, Inc., Idaho Falls, ID.
THE ROLES AND FUNCTIONS OF A LUNAR BASE NUCLEAR TECHNOLOGY CENTER
D. Buden and J. A. Angelo, Jr. (Science Applications International Corp., Melbourne, FL.) 1991 9 p Presented at the 42nd International Aeronautical Federation Congress (IAEFC), Montreal, Quebec, 7-11 Oct. 1991 Previously announced in IAA as

A92-13161
(Contract DE-AC07-76ID-01570)
(DE92-003325; EGG-M-91483; CONF-9110217-4) Avail: NTIS HC/MF A02

This paper describes the roles and functions of a special Nuclear Technology Center which is developed as an integral part of a permanent lunar base. Numerous contemporary studies clearly point out that nuclear energy technology will play a major role in any successful lunar/Mars initiative program and in the overall establishment of humanity's solar system civilization. The key role of nuclear energy in the providing power has been recognized. A Nuclear Technology Center developed as part of a permanent lunar base can also help bring about many other nuclear technology applications, such as producing radioisotopes for self-illumination, food preservation, waste sterilization, and medical treatment; providing thermal energy for mining, materials processing and agricultural; and as a source of emergency habitat power. Designing such a center will involve the deployment, operation, servicing and waste product management and disposal of megawatt class reactor power plants. This challenge must be met with a minimum of direct human support at the facility. Furthermore, to support the timely, efficient integration of this Nuclear Technology Center in the evolving lunar base infrastructure, an analog of such a facility will be needed here on Earth. DOE

N92-18810*# California Inst. of Tech., Pasadena. Experimental Geophysics Seismological Lab.
PLANETARY CRATERING MECHANICS
John D. OKeefe and Thomas J. Ahrens Feb. 1992 53 p
(Grant NsG-1953)
Avail: NTIS HC/MF A04 CSCL 03B

To obtain a quantitative understanding of the cratering process over a broad range of conditions, we have numerically computed the evolution of impact induced flow fields and calculated the time histories of the major measures of crater geometry (e.g., depth diameter, lip height ...) for variations in planetary gravity (0 to 10 exp 9 cm/sq seconds), material strength (0 to 140 kbar), thermodynamic properties, and impactor radius (0.05 to 5000 km). These results were fit into the framework of the scaling relations of Holsapple and Schmidt (1987). We describe the impact process in terms of four regimes: (1) penetration; (2) inertial; (3) terminal; and (4) relaxation. Author

92 SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots.

For related information see *93 Space Radiation.*

N92-18856# Pennsylvania Univ., Philadelphia.
MEASUREMENT OF SOLAR NEUTRINOS IN KAMIOKANDE-2
E. Beier Nov. 1991 8 p
(Contract DE-FG02-89ER-40496)
(DE92-005344; DOE/ER-40496/1) Avail: NTIS HC/MF A02

Work performed under this grant has resulted in the first direct observation of neutrinos produced by nuclear fusion reactions in the core of the sun. The quantitative results not only are the first direct confirmation that nuclear fusion is the source of solar power, but also place strong constraints on the properties of the neutrinos. During the course of the work, neutrinos from supernova SN1987a were observed. The observation of this signal confirms an important hypothesis of nuclear astrophysics, that gravitational collapse of the core of a massive star which has used up its nuclear fuel produces such as dense state of nuclear matter that neutrino emission is the principal mechanism for the escape of energy from the collapsed core. DOE

N92-18880# Johns Hopkins Univ., Laurel, MD. Applied Physics Lab.
SOLAR VECTOR MAGNETIC FIELD RESEARCH Annual Report, 1 Dec. 1990 - 30 Nov. 1991
David M. Rust 30 Nov. 1991 26 p
(Grant AF-AFOSR-0102-90; AF Proj. 2311)
(AD-A244403; AFOSR-91-1031TR) Avail: NTIS HC/MF A03 CSCL 03/2

Observations have been made before and after a large solar flare. Magnetic features were observed that could be used to predict flares if they are a regular feature of such events. The observations were among the first to show the development of shear within one hour of flare onset. Observations of linear polarization have been made of transient brightenings at small points in the lower chromosphere. The association between these flare-like events and magnetic fields has been studied. A feasibility study has been made of observing the sun with a balloon-borne vector magnetograph. The APL vector magnetograph developed under an OSR URI is operational. GRA

N92-18910# Bern Univ. (Switzerland). Div. of Solar Observations.
BERNE SOLAR OBSERVATIONS: DATA FOR JUL. 1990 - JUN. 1991
A. Magun, M. Fuhrer, M. Graeter, R. Herrmann, E. Rolli, and A. Marti 1991 42 p
(Rept-58; ETN-92-90659) Avail: NTIS HC/MF A03

Solar data for the period from Jul. 1990 - Jun. 1991 compiled by the Institute of Applied Physics of the University of Berne (Switzerland) is presented. Outstanding solar events over this time period are listed in tabular form indicating the day of the month, the type of event, the start and duration of the event, the peak values, and the flux of the event. ESA

93 SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts.

For biological effects of radiation see *52 Aerospace Medicine.* For theory see *73 Nuclear and High-Energy Physics.*

N92-18273*# Fermi National Accelerator Lab., Batavia, IL.
GRAND UNIFIED THEORIES, TOPOLOGICAL DEFECTS AND ULTRAHIGH-ENERGY COSMIC RAYS
Pijushpani Bhattacharjee, Christopher T. Hill, and David N. Schramm (Chicago Univ., IL.) Oct. 1991 12 p
(Contract NAGw-1321; NAGw-1340; NSF INT-91-10117; NSF AST-91-22629; DE-FG02-91ER-40606)
(NASA-CR-189841; NAS 1.26:189841; FERMILAB-Pub-91/304-A)
Avail: NTIS HC/MF A03 CSCL 03B

The ultrahigh-energy (UHE) proton and neutrino spectra resulting from collapse or annihilations of topological defects surviving from the GUT era are calculated. Irrespective of the specific process under consideration (which determines the overall normalization of the spectrum), the UHE proton spectrum always 'recovers' at approximately 1.8 x 10 exp 11 GeV after a partial Greisen-Zatsepin-Kuz'min 'cutoff' at approximately 5 x 10 exp 10 GeV and continues to a GUT-scale energy with a universal shape determined by the physics of hadronic jet fragmentation. Implications of our results are discussed. Author

N92-18335# Max-Planck-Inst. fuer Physik und Astrophysik, Garching (Germany, F.R.). Werner-Heisenberg Inst. fuer Physik.
AN ANGLE INTEGRATING AIR CERENKOV COUNTER ARRAY FOR IMPROVED GAMMA/HADRON SEPARATION IN EXTENDED AIR SHOWERS
M. Bott-Bodenhausen, I. Holl, A. Kabelschacht, A. Karle, E. Lorenz, R. Maier, M. Merck, W. Pimpl, M. Rozanska (Polish Academy of Sciences, Cracow.), and P. Weisbach et al Jul. 1991 53 p
Prepared in cooperation with Universidad Complutense, Madrid, Spain
(MPI-PhE/91-01; ETN-92-90627) Copyright Avail: NTIS HC/MF A04

An array of angle integrating air Cerenkov counters are proposed to be integrated into the HEGRA scintillation counter matrix on La Palma (Spain). The new array will be sensitive to extended air

showers of energies in excess of 5 x 10(exp 13) eV and of zenith angles up to 35 degrees. Determination of the incident shower direction is performed by fast timing measurements with an angular resolution of 0.5 to 5 mrad. The Cerenkov counters will allow information on the shower energy and structure higher up in the atmosphere to be obtained. ESA

N92-18374# International Centre for Theoretical Physics, Trieste (Italy).
ELECTROMAGNETIC RADIATION FROM A GLOBAL COSMIC STRING IN AN EXTERNAL MAGNETIC FIELD
D. D. Harari (Instituto de Astronomia y Fisica del Espacio, Buenos Aires, Argentina) and F. D. Mazzitelli Mar. 1991 12 p
(DE92-603665; IC-91/52) Avail: NTIS HC/MF A03

A global cosmic string may couple to electromagnetism as a consequence of anomalous triangle diagrams. In an external magnetic field, the gradients of the Nambu-Goldstone boson field around the string give rise to an extended polarization current. When the string oscillates, it radiates electromagnetic waves. We estimate the strength of the effect for representative values of astrophysical magnetic fields. We also discuss implications for axion strings if a primordial cosmological magnetic field existed at early times. DOE

N92-18543# Los Alamos National Lab., NM.
PROPERTIES OF MULTIPLE EVENT GAMMA RAY BURSTS
J. C. Lochner 1991 6 p Presented at the Gamma Ray Burst Conference, Huntsville, AL, 17-18 Oct. 1991
(Contract W-7405-eng-36)
(DE92-004574; LA-UR-91-4165; CONF-9110310-1) Avail: NTIS HC/MF A02

We present results from a study of 37 multiple event gamma ray bursts found in the monitoring data of the PVO gamma ray burst detector. We define these bursts as those which have two or more distinct emission events separated by a return to the background intensity. Significant correlation exists between the duration of the first event and the duration of the second event, while some correlation exists between the hardness of the events and only weak correlation exists in the intensity of the events. Although the time profiles of events in a burst may be similar, as measured in the phase portrait, there is no general rule about the degree of similarity of the time profiles. Subdividing the data according to the recurrence time, we find a tendency for the strength of the correlation in the hardness to increase with decreasing separation between the events. DOE

N92-18770# Los Alamos National Lab., NM.
MEASURING NEUTRON FLUENCES AND GAMMA/X RAY FLUXES WITH CCD CAMERAS
G. J. Yates, G. W. Smith, P. Zagarino, and M. C. Thomas 1991 13 p Presented at the IEEE Nuclear Science Symposium, Santa Fe, NM, 5-9 Nov. 1991
(Contract W-7405-eng-36)
(DE92-003863; LA-UR-91-3526; CONF-911106-29) Avail: NTIS HC/MF A03

The capability to measure bursts of neutron fluences and gamma/x-ray fluxes directly with charge coupled device (CCD) cameras while being able to distinguish between the video signals produced by these two types of radiation, even when they occur simultaneously, has been demonstrated. Volume and area measurements of transient radiation-induced pixel charge in English Electric Valve (EEV) Frame Transfer (FT) charge coupled devices (CCD's) from irradiation with pulsed neutrons (14 MeV) and Bremsstrahlung photons (4-12 MeV endpoint) are utilized to calibrate the devices as radiometric imaging sensors capable of distinguishing between the two types of ionizing radiation. Measurements indicate approx. = .05 V/rad responsivity with greater than or = 1 rad required for saturation from photon irradiation. Neutron-generated localized charge centers or 'peaks' binned by area and amplitude as functions of fluence in the 10(exp 5) to 10(exp 7) n/cc range indicate smearing over approx. 1 to 10 percent of the CCD array with charge per pixel ranging between noise and saturation levels. DOE

99 GENERAL

N92-18455*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, OH.
NASA SPACE APPLICATIONS OF HIGH-TEMPERATURE SUPERCONDUCTORS
Vernon O. Heinen, Martin M. Sokoloski (National Aeronautics and Space Administration, Washington, DC.), Paul R. Aron, Kul B. Bhasin, Edwin G. Wintucky, and Denis J. Connolly 1992 9 p Presented at the Fourth International Symposium on Superconductivity, Tokyo, Japan, 14-17 Oct. 1991; sponsored by the International Superconductivity Technology Center
(NASA-TM-105401; E-6801; NAS 1.15:105401) Avail: NTIS HC/MF A02 CSCL 20K

The application of superconducting technology in space has been limited by the requirement of cooling to near liquid helium temperatures. The only means of obtaining these temperatures has been with cryogenic fluids which severely limit mission lifetime. The development of materials with superconducting transition temperatures above 77 K has made superconducting technology more attractive and feasible for employment in aerospace systems. Here, potential applications of high temperature superconducting technology in cryocoolers, remote sensing, communications, and power systems are discussed. Author

N92-18560# Oak Ridge National Lab., TN.
ORNL '90
T. Anderson, ed., D. Barnes, ed., and J. Jefferson, ed. 1990 62 p
(Contract DE-AC05-84OR-21400)
(DE92-004801; ORNL/PPA-90/1) Avail: NTIS HC/MF A04

This overview of research conducted at ORNL in 1991 presents information on the subjects of biology, physics, and the environment. Specific topics include gene mutations in kidney disease, technology assessments in thermonuclear fusion, submarine hunting technology, ozone-safe refrigerants, optical data storage via surface enhanced raman spectroscopy, and waste mitigating microbes. DOE

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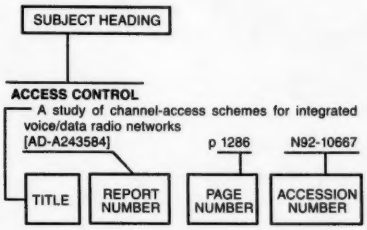

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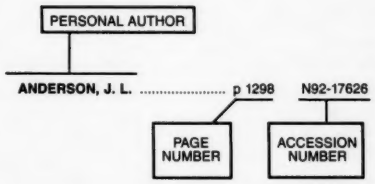

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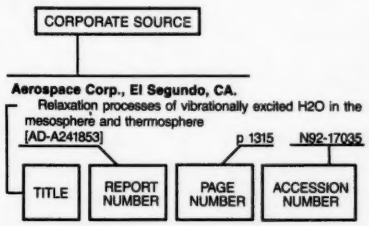

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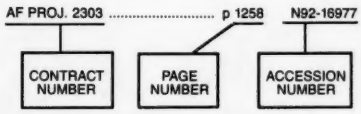

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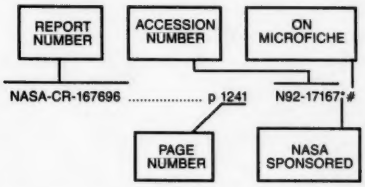

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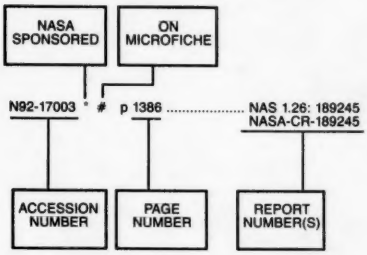

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